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AN ENGINEERING FEAT.

A feature of electrical engineering which attracted little notice was quietly accomplished in New York city the other day, when the Stock Exchange moved from its old quarters to new ones several hundred yards distant. One working day, Saturday, was omitted, and in the interval between Friday evening and Monday morning the whole of the vast complex of telephones, telegraphs and stock ticker instruments, signals, call bells, private lines and all the rest of the electrical paraphernalia of the Exchange was moved and set up in its new quarters, properly connected to outgoing and incoming circuits and turned on without a hitch. It was a gigantic feat and one worthy to be recorded and remembered.

DOING THINGS.

In all of the history of the American people there has never been a time when industrial activity was so pronounced and widespread as it is to-day. In every department of human effort work of a telling character is being done and nowhere is this more evident than in the arts dependent upon electrical engineering.

Whether it be due wholly to the natural genius of the people, or in part to circumscribing conditions, it is evident that the centre of the world's industrial activity is now to be found in the United States. The city of New York has become the monetary centre of the commercial world, while the export trade of America, insignificant a generation ago, has grown by leaps and bounds to proportions of astonishing magnitude. In all of the engineering industries we stand preeminently in the lead, except, possibly, in the one matter of shipbuilding, and even in this the outlook is excellent.

In electrical engineering we leaped with the invention and popularization of the telephone to first place, and have held it ever since, even increasing our lead over our competitors in this regard. The productive capacity of our industrial establishments has increased to such a point that the home market afforded us by our own demand has been outgrown, and trade is reaching out in every direction to find new fields for expansion and new opportunities for placing the product of American shops and factories.

In an exceedingly felicitous speech made a few days ago, President McKinley said:

"We have never had so much to do in all our history as we have now. We never had so much business at home, nor so much abroad. We never made so much and never sold so much as we shall sell this year. We are expanding our markets. Our productive capacity has become so great that we are not only able to supply the home markets, but we require a foreign market for our surplus; and so we are seeking an open door in the Orient for the products of American soil and American labor."

These remarks sum up in the tersest phrases the whole situation, but we must remember that in order to avail ourselves best of the open door in the East, and in order best to hold the advantages that we have gained, both by military conquest and the even more certain process of trade expansion, we must have immediate and sufficient means of communication with this distant market. As it is at present, a manufacturer or exporter on the Pacific coast, in order to reach his comparatively near export market in Japan or China, has to telegraph three-quarters of the way around the world. The transpacific cable is an absolute necessity indicated by every consideration of commerce and military necessity. That it will surely be built is perfectly evident because of the fact that there is enough guaranteed business for it at present to make it pay. It is not usual for American investors and engineers to allow an opportunity of this character to pass them.

With the extension of these eastern markets and the opening of the vast populations of the other shore of the Pacific to commercial relations, there will come the necessity of exploitation to the fullest limit of the magnificent natural resources of our Pacific states, which seem destined to become a centre of manufacturing industries to supply this transpacific demand.

Some one has recently written that nature worked wisely in placing Niagara Falls near the centre of the most populous part of North America and allowing us to make it available when it had become most necessary. Nature has similarly played a wise part in providing the Pacific coast of the United States with parallel ranges of mountains, giving rise to some of the finest water powers on the face of the earth, and these located within easy electric transmission distance of abundant shipping facilities for manufactured products. With the up-building of the eastern market must come the up-building of our western states as centres of manufacture, and coincident with this up-building will be a general increase in the productive output of the whole country, especially in that which concerns us most, its electrical and mechanical machinery and manufactures.

THE TELEPHONE IN RAILWAY SIGNALING.

The experiment of the Erie Railroad Company in equipping its system of block stations with telephones is one that should be regarded with much interest by all railway managers. It has not been attempted to do away with the ordinary telegraph block signaling system with telephones, but the latter have been found to be an adjunct of great utility. Inasmuch as a special training is not needed for its operation, the company has a large field from which to recruit its force of signalmen, and in many cases the telegraph signal has actually become superfluous. While it takes some time for a man to learn to telegraph with the accuracy and certainty that are so particularly requisite in railway signaling work, any man that can talk and hear can operate the telephone with satisfaction. The subject is one of real importance, and deserves the careful consideration of telephone manufacturers, and railway managers as well. In another column, Mr. F. L. Blendinger, superintendent of telegraph of the Erie Railroad Company, has described in an interesting manner the method in use on his system.

MAKING FERTILE THE WASTE PLACES.

On the Pacific coast of the United States there exist alongside one another high ranges of mountains abounding in torrential streams fed from the vast snow fields of the upper peaks, and deserts of most forbidding aridity which need only the vivifying water to make them bloom into gardens of wonderful fertility. The consequences of this state of things are that colossal engineering works have been undertaken and constructed with entirely satisfactory results for bringing the water of the mountain streams to the dry desert plains for irrigation purposes, and, indeed, much of the astonishing agricultural prosperity of this section of the country rests upon the diversion of water courses for this benevolent purpose.

In the earlier irrigating works the water was led by flume and canal through irrigating ditches to the soils which required it, and was used, every drop of it, apparently to the best advantage, but one thing which the water originally contained, of as much value as its vitalizing effect upon the desert, was lost irretrievably. This thing was its potential energy.

Of late this fact has been recognized, and the water, in falling from the high levels of the mountains to fulfill its work of irrigation on the plains, has been made to pass through turbine-wheels and generate power. The extraordinary possibilities that engineering has brought to the regions wherein this industrial miracle has been wrought are almost beyond comprehension. California, for example, has districts where irrigation, combined with electric utilization of water power, seems to promise an actual production of wealth greater than could be measured by all the gold ever dug out of the soil of that state. Facing, as it does, the crowded East, whose commerce is predestined by the inexorable law which governs the paths of trade to be ours some day, this region has in itself, though hidden from the casual view by the apparent sterility of the country, possibilities so great that they defy description. It is inevitable that manufacturing industries of great importance will spring up around the water powers of that region, while the water itself, having done its work in turning the dynamo, will furnish in conjunction with the seemingly desert soil food for the great influx of population that this manufacturing will entail. It is indeed a place in which Nature has planned wisely for the future.

TECHNICAL EDUCATION.

Our esteemed contemporary, the *Electrical Engineer*, of London, in editorially discussing educational systems, presents several queries and suggestions. We are pleased to note that our contemporary acknowledges that the Americans are capable of the initiative in constructive work and that we also possess equality with our English brethren as to brains. The editorial is as follows:

"How far does proper systematic education lead to invention or the perfection of the crude invention? It seems to us that its sphere more directly concerns the latter than the former. Examine into a few of the great departures of the past. Watt, who practically gave us the modern steam-engine, can hardly be said to have been the product of scholasticism. Stephenson, who evolved the germ of the modern locomotive, was a self-taught man. 'Brinley, the neglected son of a dissipated father,' hardly able to write his own name, carried out works to surpass which would tax the abilities and experience of many of the great engineers of the present day. Harrison, a poor carpenter, gave us the chronometer, while Arkwright gave up his trade of collecting hair from barbers in order to devote his attention to the introduction and perfection of Wyatt's idea of spinning by machinery. Arkwright was steeped in poverty, unable to spell or write correctly, once mistaken for a vagabond; yet he triumphed, and gave 'Britain a new character in the commercial world.' Dr. Cartwright, knowing nothing of mechanics, who had never seen a loom previous to making his own, evolved the power loom. A blind man constructed many of our best roads. Coming to recent years, and more directly to electrical engineering matters, we fancy that neither Edison, Gramme, nor Swan had scientific training in the modern acceptation of the term. Bell was probably more a philologist than a physicist. Nature endowed these men and others that might easily be named with inventive powers, while education endowed other men equally well known with the acumen to investigate, the power and ability to suggest and execute the alterations required to bring about greater perfection in the apparatus originally devised. We may be altogether wrong, but appeal to history seems in our favor, that scholastic training rather retards and trammels the inventive faculty, while it increases even when it does not create the power of perfecting what is obtained in a crude state. We are fain to admit the chemist to be in a somewhat different category to other workers. Here the laboratory reigns almost supreme; analysis and synthesis are the tools of the expert, and to the expert we look for progress.

'For many long years we have initiated improvements, and there is no indication that we are yet played out. Our cousins in America—men of our own race and blood—are quite as capable as ourselves in initiating, and it would be a strange spectacle if one brother arrogated to himself the power to start without remembering that his brother with the same training as himself possessed similar advantages, and was quite capable of making a start also. Why deny equality to the brains of America? So doing seems childish. We simply deny superiority either of intellect or energy. Here is the whole case in a nutshell. Professor Perry says: 'Much of the evil we suffer from' (we do not agree that the evil exists) 'is due to our average young men being pitchforked into works where they get no instruction as soon as they leave school.' 'Where they get no instruction'—well, let the *proper* instruction go on contemporaneously with the practical work. The words of a writer in the fifties are as true to-day as they were then, and we fear the fact portrayed by them has as much to do with our present position as anything. The writer says: 'It is a singular and a mournful fact that every one of the great improvements to which Britain owes her present prosperity has fought its way in the world against clamour, knavery, and contempt.'"

ELECTRICAL INVENTION.

About ten years ago one could hardly ever hear electricity spoken of, or see a paragraph of more than ten lines written in the lay press concerning it, without meeting the ancient and time-worn remark that "electricity is in its infancy." Whether the people have become tired of speaking of the infancy of an industry which makes many of the old-established arts look small by comparison, or whether they have actually begun to realize that electrical engineering is exceedingly mature and remarkably perfect, is hard to say. But notwithstanding the decadence of this phrase, one is almost tempted to revive it when he looks at the Patent Office records. Notwithstanding the exceedingly advanced condition of the electrical industry and the extraordinary perfection to which most electrical appliances have reached, invention seems as active as ever, and the Patent Office weekly turns out large numbers of patents in the electrical field. These are by no means restricted to small devices or improvements, for within the last year there have been taken out a number of patents which it requires no prophetic vision to see are of fundamental and vital importance. That such a state of things should be is certainly astonishing, but nevertheless it is true that the volume of electrical patents seems to increase rather than diminish, and this confirms us in the belief that notwithstanding the steadiness and maturity of its growth, electricity still has a long and vigorous future before it.

As one reviews the progress of electrical application through the past and sees how it has gone first from signaling at a distance to that astonishing modification of the telegraph whereby speech can be transmitted, thence to lighting, which field it has preempted for its own, thence to applications for motive power and transportation at first on a small scale and now gradually increasing—no one who looks at this history with intelligence can avoid the belief that other great fields of activity will open up one after the other for the application of electric methods. The handling of passenger transportation in cities has become practically entirely electrical during the last four or five years; that the transportation of merchandise and passengers on longer railways running through the country will soon become electrical no one can either doubt or deny. In what new direction the next great advance will be made is a question that rests with the future, but viewing both the past progress of the art, its present status, and the intelligent and seemingly increasing activity in it, we are led irresistibly to conclude that electricity has only entered on the career of usefulness which it is destined to fulfill.

THE NATIONAL ELECTRIC LIGHT CONVENTION.

The selection of Niagara Falls for the annual convention of the National Electric Light Association, which is to be held at that point May 21, 22 and 23, was an exceedingly happy one. It has been a question that has agitated the minds of dwellers in that region for some time whether Buffalo is a suburb of Niagara Falls, or vice versa. At any rate, there are gathered at the two places this Summer exhibits which can not fail to be intensely interesting to all electric light people. One of them is, of course, Niagara Falls itself and the electrical industries that are gathered around it, while the other is the Pan-American Exposition with its fine display of electrical apparatus and methods.

The preliminary programme of the meeting, which is published elsewhere in this issue, is one that holds out promise for a very attractive convention. From present indications it is believed that the attendance will be the largest in the history of the association, and that many, if not a majority, of the members will avail themselves of the opportunity to bring with them their families and make the occasion one of particular pleasure and interest. Everybody always has a good time at conventions held at Niagara Falls, whether because the convention itself is in a measure condensed and compelled to attend to its legitimate functions without the straggling away of delegates which always takes place in a large city, or because of the general festival atmosphere that surrounds the greatest of our national playgrounds. In May at Niagara the weather is generally delightful, and it is a safe prediction that no meeting of the association has ever had such fair promise for success, and no convention ever before had such side-shows as are furnished by the Niagara plants and the Exposition, 25 miles away.

PUBLIC ELECTRICAL VEHICLE SERVICE.

In this journal last week was presented a complete description of the new charging station and headquarters of the New York Electric Vehicle Transportation Company's public electric cab service in New York city. This is the most complete and the largest establishment of its kind in the world and is particularly interesting, since it deals with a branch of electrical engineering of which little is known and which lies directly in the path of progress. The elaborate and exceedingly efficient installation reflects no little credit upon Mr. G. Herbert Condict, the electrical engineer of the company.

An inspection of this fine station leaves a permanent impression in the mind of the visitor that the demand for a proper automobile storage battery is so crying that it soon must result in the appearance of the desired accumulator. Everywhere in the history of industrial progress invention has followed close in the wake of necessity. Whenever new conditions have created a strong demand for new methods or new appliances, the latter have been forthcoming and, indeed, only rarely has invention outstripped the need for it and found itself without a market.

The continued success of this company in New York city, where the conditions for operation of electric vehicles are exceedingly difficult, is perhaps the strongest demonstration of the value and commercial excellence of the electric automobile to-day. In all sorts of weather, in the face of strong competition, on ill-paved streets and under conditions of the utmost difficulty, these cabs have held their own and to-day, although 350 of them are in service, the company finds its greatest difficulty in its inability to supply the demand upon it for transportation service. It could easily handle three times the number of cabs and still leave orders unfilled. This speaks volumes for the popular success of the electric automobile in city transportation.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXVI.

BY W. ELWELL GOLDSBOROUGH.

The equation which expresses the reactions which take place in the circuit shown in Fig. 71 is readily developed from equation (54), page 596, vol. xxxvii, when once the equivalent resistance and inductance of the system are known.

Since the circuit OA_1 is a parallel circuit we must apply the formulæ developed on pages 272, 274 and 300 in evaluating the equivalent resistance and inductance of this circuit. The conductance of the circuit O′A′ is

$$g_2' = \frac{r_2'}{(r_2')^2 + (x_2')^2}$$

and its susceptance is

$$b_2' = \frac{x_2'}{(r_2')^2 + (x_2')^2}.$$

And the conductance and susceptance of the circuit O″A″ are respectively

$$g_2'' = \frac{1}{r_2''} \text{ and } b_2'' = 0.$$

Therefore, by equations (171) and (172), page 274 and (174) and (175), page 300, the equivalent resistance of the circuit OA_1 is

$$r_2 = \frac{g_2' + g_2''}{(g_2' + g_2'')^2 + (b_2')^2}$$

and the equivalent reactance of the circuit OA_1 is

$$x_2 = \frac{b_2'}{(g_2' + g_2'')^2 + (b_2')^2}.$$

From these deductions and equation (54) we have then that the current flowing in the system shown in Fig. 71 is determinable by applying the equation

$$I = \frac{E}{\sqrt{(r_1 + r_2)^2 + (x_1 + x_2)^2}}$$

$$= \frac{E}{\sqrt{\left(r_1 + \frac{g_2' + g_2''}{(g_2' + g_2'')^2 + (b_2')^2}\right) + \left(x_1 + \frac{b_2'}{(g_2' + g_2'')^2 + (b_2')^2}\right)^2}}$$

$$= \frac{E}{\sqrt{\left(r_1 + \frac{g_2' + \frac{1}{r_2''}}{\left(g_2' + \frac{1}{r_2''}\right)^2 + (b_2')^2}\right)^2 + \left(x_1 + \frac{b_2'}{\left(g_2' + \frac{1}{r_2''}\right)^2 + (b_2')^2}\right)^2}} \quad (190)$$

In the last equation all the factors are constants except r_2''. When r_2'' is very large, r_2 and x_2 are considerable quantities, but they approach zero as r_2'' approaches zero.

It would be impossible to obtain any adequate conception of the changes in the value of I when r_2'' decreases by an inspection of (190) alone, but when the latter is interpreted with the aid of Fig. 73 these changes are clear enough.

Something more can be gained by plotting the vector values of Fig. 73 in rectangular coordinates. To accomplish this some one of the several varying vectors must be taken as a reference factor or the independent variable and the other vector values plotted relatively thereto.

Fig. 74 presents such an assemblage of rectangular coordinate curves plotted relatively to the values of the current in the variable resistance circuit O″A″ of Fig. 71 taken as abscissas. As ordinates to the instantaneous values of I_2'', are plotted the generator electro-motive force E; the electro-motive force E_1 apparent at the terminals A_1 and A of the line; the electro-motive force E_2 apparent at the terminals O and A_1 of the receiver circuit; the values of the main current I; the values of the angle of lag ϕ_2 of I behind E_2; and the values of the variable resistance r_2'' of the circuit O″A″.

The rectangular coordinate curves are especially valuable in that they illustrate the effect of line reactance upon the electro-motive force at the terminals of a receiver when the latter is loaded non-inductively. The conditions imposed are analogous to those existing in a transformer circuit in which a non-inductive load of incandescent lamps are placed on the transformer secondary. This analogy will be taken up in a more detailed way later.

Example 15.

Given: A distributing system such as that shown in Fig. 71, in which an alternator G developing a pressure of 1,000 volts at 60 cycles is impressed upon the receiving circuit T through a line L the resistance of which is 26.2 ohms and which has a reactance of 52.2 ohms. The inductive circuit of the receiver T has a resistance of 65 ohms and a reactance of 242 ohms, while the non-inductive circuit of the receiver varies in its resistance from ∞ to 250 ohms, to 125 ohms, to 83 ohms and to 63 ohms. The internal resistance and reactance of the armature of the generator G are small and may be neglected.

Determine what voltage values will appear at the terminals of the receiving circuit as the resistance is varied. Further determine the lag of the line current behind the receiver electro-motive force for each value of the resistance. And, finally, develop a set of characteristic curves to show the performance of the receiver under the conditions imposed.

If a direct mathematical method were employed in the solution of this problem, obviously the thing to do would be to substitute the given values of the line and receiver constants in equation (190), and from the main current values found in this manner calculate the values of the receiver voltage and current lag by applying equations (165), (171) and (174). However, a semi-graphical method possesses advantages over a purely mathematical one in the solution of a problem of this class and will be employed here.

In solving the problem graphically the best results are obtained by assuming that a certain current is flowing in the system and then building up the vector diagram to correspond with this assumption. By this means a diagram is produced that has the form of the required diagram, although it may be either larger or smaller than the required diagram, if the latter is to show a certain constant impressed electro-motive force. However, when once a diagram is secured it is but a matter of proportion to express its vector lengths in units that will make a direct comparison with the given impressed voltage possible.

In the present instance, for the sake of simplicity, a series of values will be assumed for the current in the circuit O″A″, corresponding to the changes in the resistance of the circuit O″A″, which will make the electro-motive force at the terminals OA_1 have the uniform value of 1,000 volts. Therefore, dividing 1,000 by ∞, 250, 125, 83 and 63, respectively, we find that the several currents assumed for the circuit O″A″ must have the values 0, 4, 8, 12 and 16 amperes. These are tabulated in Table 7.

Turn now to Fig. 72. Lay off OA_1 equal to 1,000 volts, and on it construct the electro-motive-force triangle $OC_2^aA_1$ to represent the forces acting in the receiver circuit O′A′ when the receiver circuit O″A″ has an infinite resistance. The current in the receiver circuit at this time is by (54) equal to

$$I^a = \frac{1{,}000}{\sqrt{65^2 + 242^2}} = 4 \text{ amperes,}$$

therefore $OC_2^a = 260$ volts and $C_2^aA_1 = 966$ volts. Now from A_1 and parallel to OC_2^a lay off $A_1C_1^a$ equal to the receiver current multiplied by the line resistance, then

$$A_1C_1^a = I^a r_1 = 105 \text{ volts.}$$

From C_1^a draw the line $C_1^aC_1^e$ parallel to the line OA_1. This will be the locus of the vector head C_1^a as the resistance r_2'' of the receiver circuit O″A″ is reduced.

At C_1^a erect a perpendicular equal to the product of the line reactance and the current, then

$$C_1^aA^a = I^a x_1 = 209 \text{ volts,}$$

and joining A_1 and A^a we have

$$A_1A^a = E_1 = 233 \text{ volts}$$

or the electro-motive force required to overcome the impedance of the line. Since we now have OA_1, the receiver voltage, and A_1A^a, the line voltage, determined, the generator voltage is equal to their vector sum or to

$$OA^a = E^a = 1{,}228 \text{ volts.}$$

The several values of the receiver current I_2'' must be laid off in phase with OA_1, as the circuit O″A″ is a non-inductive one, but the initial current I^a must be laid off in phase with the resistance electro-motive-force vector OC_2^a. As, therefore, $I^a = OB^a$, the line B^aB^e must be the locus of the vector head B^a as r_2'' is reduced.

When $r_2'' = 250$ ohms,

$$I_2'' = OB_{2/}{}^b = 4 \text{ amperes,}$$

and since OB^a is constant in its value and phase position as long as OA_1 is constant,

$$OB^b = I^b = 6\ 3 \text{ amperes}$$

is the resultant receiver current. With I^b known we can draw $A_1C_1^b$ parallel to OB^b from A_1 until it intersects $C_1^aC_1^e$ in C_1^b. Then at C_1^b we can erect a perpendicular $C_1^bA^b$. Now since

$$A_1C_1^b = I^b r_1 = 165 \text{ volts,}$$

if we make

$$C_1^bA^b = I^b x_1 = 329 \text{ volts}$$

we will have determined the new value of the line electro-motive force,

$$OA^b = E^b = 1{,}340 \text{ volts.}$$

With the points A^a and A^b once located the work can progress very rapidly for a line drawn through A^a and A^b determines the position of the locus of the vector head of the generator electro-motive force under the provisional assumption of a constant receiver electro-motive force.

To complete the data lay off $OB_{2/}{}^c = 8$ amperes, draw $B_{2/}{}^cB^c$ parallel to OB^a. Then $OB^c = I^c = 9.8$ amperes. Draw $A_1C_1^c$ parallel to OB^c and at C_1^c erect a perpendicular to $A_1C_1^c$, extending it until it intersects A^aA^b at A^c; then connect A_1A^c and OA^c. By measurement we now have all the data for the third case, as

$$OC_2^c = E_{2r}^c = 921 \text{ volts.}$$
$$C_2^cA_1 = E_{2x}^c = 394 \text{ "}$$
$$A_1C_1^c = E_{1r}^c = 257 \text{ "}$$
$$C_1^cA^c = E_{1x}^c = 510 \text{ "}$$
$$A_1A^c = E_1^c = 566 \text{ "}$$
$$OA^c = E^c = 1{,}479 \text{ "}$$

By a further application of the same method all the data in Table 7 is readily obtained, and we are then in a position to proceed with the second step in the solution of the problem.

The first thing required in the second step is that we lay out a second table (Table 8) in which to tabulate corrected data. Then each set of readings in Table 7 must be reduced in the ratio of 1,000 to each voltage E of each set. By this process of reduction the values in Table 8 are obtained.

TABLE 7.

	Ohms. r_2''.	Amperes. I_2''.	Volts. E_{2r}.	Volts. E_{2x}.	Volts. E_2.	Amperes. I.	Volts. E_{1r}.	Volts. E_{1x}.	Volts. E_1.	Volts. E.
a	∞	0	260	966	1,000	4	105	209	233	1,228
b	250	4	795	611	1,000	6.3	165	329	368	1,340
c	125	8	921	394	1,000	9.8	257	510	566	1,479
d	88	12	960	286	1,000	13.6	366	700	782	1,640
e	63	16	975	221	1,000	17.5	457	892	1,000	1,815

TABLE 8.

	Volts. E.	Volts. E_1.	Volts. E_2.	Volts. E_{1x}.	Volts. E_{1r}.	Volts. E_{2x}.	Volts. E_{2r}.	Amperes. I	Degrees. ϕ_2.	Amperes. I_2''.	Amperes. I_2'.
a	1,000	190	815	170	85	787	212	3.3	75	0	3.3
b	1,000	275	746	245	123	456	593	4.7	38	3.0	3.0
c	1,000	383	675	345	173	266	622	6.6	23	5.4	2.7
d	1,000	477	610	427	243	174	585	8.3	17	7.3	2.4
e	1,000	551	551	491	252	121	537	9.6	13	8.8	2.3

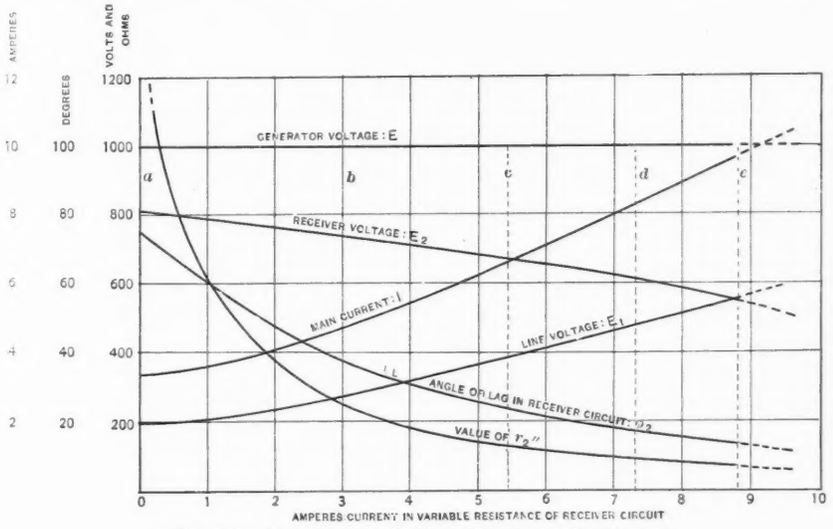


FIG. 74.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

In the fourth column of Table 8 we have the voltage that appears at the terminals of the receiver T for the different loads imposed upon the system by the changes in the receiver resistance r_2'', under the conditions of a constant generator electro-motive force. In Fig. 74 we have these values plotted in rectangular coordinates against the receiver current in the circuit O″A″. The curve shows that as the load comes on the receiver the line reactance causes the voltage impressed at the receiver terminals to fall off at a greater and greater rate, which would reach a zero value were the resistance r_2'' reduced to zero.

To determine the difference of phase between the receiver electro-motive force and the total current we have recourse to Table 7. For since

$$\tan \phi_2 = \frac{E_{2x}}{E_{2r}}$$

by substitution the values of the angles $C_2^aOA_1$, C_2^b O A_1, etc., are easily found. They are both tabulated in Table 8 and plotted in Fig. 74. In the latter case a curve results which shows that this angle of lag diminishes as the load comes on the receiver. The rate of decrease in the lag angle is, however, small for low values of r_2''.

In Fig. 73 we have the exact phase relation of all of the quantities involved pictured in a vector diagram. Here OA

is the generator impressed electro-motive force, and the initial condition is indicated by the exponential letter a. That is, referring to the figure in connection with the a series of data of Table 8, we have.

$$A_1{}^aA = E_1{}^a = 190 \text{ volts.}$$
$$OA_1{}^a = E_2{}^a = 815 \text{ "}$$
$$C_1{}^aA = I''x_1 = 170 \text{ "}$$
$$A_1{}''C_1{}^a = I^a r_1 = 85 \text{ "}$$
$$C_2{}''A_1{}^a = Ix_2 = 787 \text{ "}$$
$$OC_2{}^a = Ir_2 = 212 \text{ "}$$

and so on in corresponding order for the voltage vectors of the remaining sets of values. In Fig. 73 only the main current is shown. The initial value is

$$OB'' = I^a = 3.3 \text{ amperes,}$$

from which the current increases to the value

$$OB^e = I^e = 9.6 \text{ amperes.}$$

In Fig. 74 the main current is plotted against the branch receiver current I_2'', and it is quite evident that as r_2'' is reduced I approaches nearer and nearer the value of I_2''.

Scientific Prizes.

The Brussels Academy of Sciences has recently announced the following prize subjects for 1901: New researches upon the compounds formed by the halogens between themselves (800 francs); the determination of the form of the principal terms introduced into the formulæ of nutation in obliquity and longitude by the elasticity of the earth's crust (800 francs); historical and critical discussion of Weber's experiments on unipolar induction, and new experiments bearing upon the laws and interpretation of this physical fact (800 francs); a contribution to the study of mixed forms with a number of series of variables, and the application of the results to the geometry of space (600 francs); history of researches on the variation of latitude, and a discussion of the interpretations of this phenomenon (600 francs); investigations of the physiological *rôle* of albuminoid substances in the nutrition of animals or plants (800 francs).

Our Prize Offer.

[*From the London Electrical Engineer.*]

The ELECTRICAL REVIEW, of New York, with praiseworthy enterprise, offers a prize of £20 for the best article upon the subject of the electric lighting central station superintendent sent in before May 1 next.

The scope of the subject is sufficiently wide, embracing, as it does, the duties of this official, how he may best fit himself for them, what steps he must take to insure success in that profession, and what type of man is best fitted by character, experience, education and brain texture for employment under conditions of great responsibility by owners of such installations,

Science Brevities

Insulating Iron Laminations—Mr. H. Leconte contributes to a French journal a description of a new proposal for insulating the iron laminations of an armature core the one from the other, says the *Electrical Engineer*. The usual means employed up to now have been either to varnish the plates, or to insert between each plate a thin layer of paper or other insulating material which has sufficient resistance to prevent any current circulating from the one iron plate to the next. The new suggestion—which, we gather, is protected—consists in covering the plates with a layer of blacklead. The blacklead, or graphite, is mixed with water and applied with a brush, and the plates are left to dry. The author suggests that it is also worth while to brush the plates after

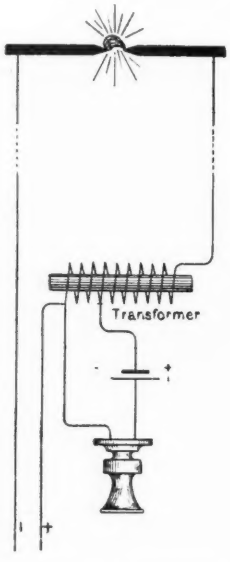


DIAGRAM OF PHOTOPHONE.

they are dry, in order to get a thin, polished coating of blacklead over the iron. He has had some armatures built up with plates insulated in this way by one or two firms on the Continent. In the first example, the core of a certain machine, when insulated with paper, contained 435 plates of a thickness of 0.55 mm., giving in all a thickness of 239 mm. of iron. The thickness of the insulation was 20.75 mm., or eight per cent of the total thickness. With the plates insulated with the graphite covering, 20 more were inserted in the same space, so that the thickness of insulation was only 3.85 per cent of the total length of the core. In this way four per cent is gained in the volume of iron. Some experiments were then made after the coils of the armature windings had been put on, from which curves have been drawn. From the information given, the loss in the iron is slightly more when the plates are insulated with blacklead than when paper is used. In the first case the iron losses were 620 watts, as against 510 watts lost in the second, while the induction through the iron was practically the same. The author states that other materials could also be used as well as blacklead, provided they could be applied in the same way.

Photophones—Herr E. Ruhmer has found that an electric arc is not absolutely essential for the transmission of speech by light. It can be accomplished by means of a simple Bunsen flame surmounted by a piece of platinum foil serving as an electrode, while the burner itself serves as the other. Mr. Fournier d'Albe says: The flame is inserted in the secondary circuit of a transformer, and a battery and microphone receiver in the primary circuit. The effect is, however, much feebler than in the case of the arc. In using the arc care must be taken to have the proper transforming ratio. The best ratio—*i. e.*, that with which the loudest rendering of the original sound is obtained—is that in which the numbers of turns in the two coils are in the proportion of the square roots of the resistances of the microphone and the arc respectively. The ratio comes out as something like 1 to 2.2. To attain this ratio empirically, and to vary it in accordance with the pitch of the note transmitted (as is often desirable), the author proposes to employ a single-coil transformer with variable contact (see diagram). At the receiving station low-resistance selenium cells should be employed. Under favorable conditions they may be made to work the recording magnet of a Poulsen telegraphone.

Electrolytic Pigments—Besides white lead, a large number of metallic colors have been made by so-called electrolytic processes. But the *rôle* of the current is in nearly all cases confined to dissolving the metal used as an anode, the solution being subsequently dealt with by ordinary chemical reactions, says *Lightning*. Inasmuch as the solutions can be made by old and simple methods without electric power, the latter, if merely used for hastening the process, would seem to be superfluous and only an additional expense. Consequently, few of the patents have proved economic successes, except, perhaps, the production of white lead, vermilion and chrome yellow. The second is made by electrolyzing a solution of sodium and ammonium nitrates and sodium sulphate with sulphur in suspension, using mercury as the anode and "steel-covered" copper as the cathode; the last by electrolyzing potassium dichromate, slightly acidified, using lead anodes.

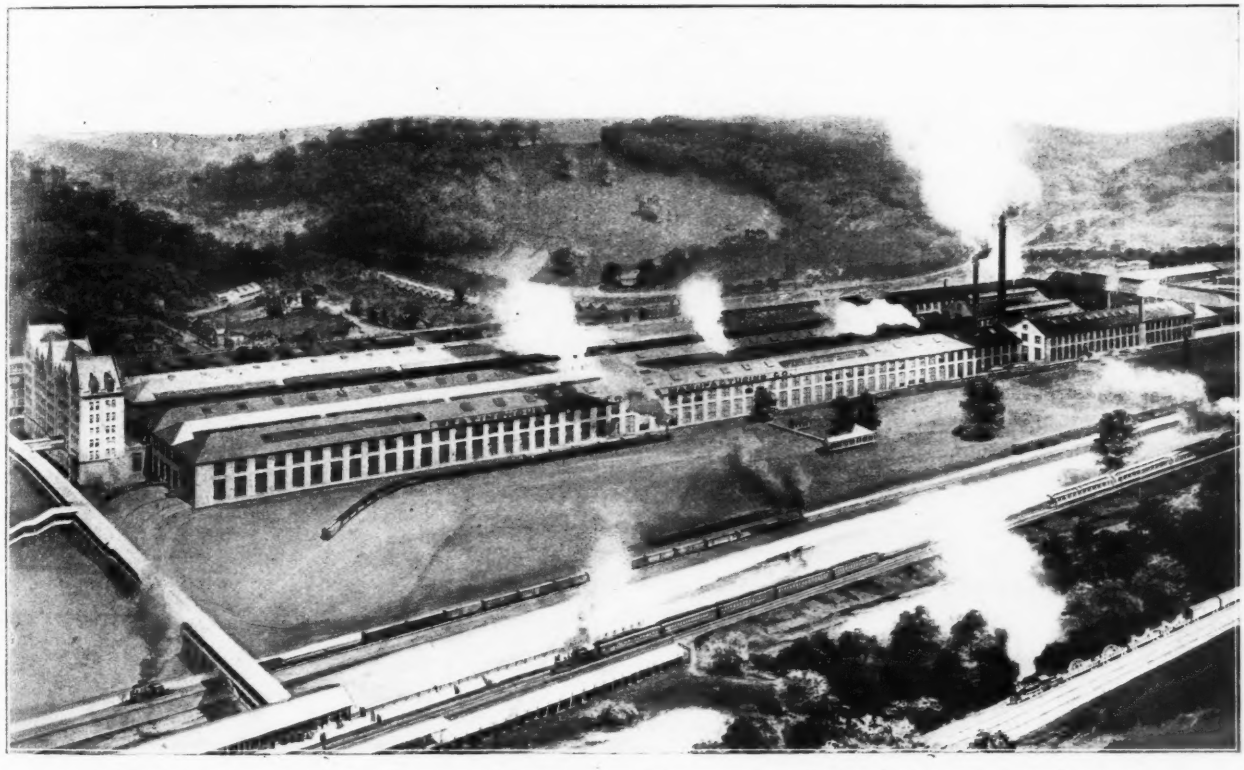
The Works of the Westinghouse Electric and Manufacturing Company—I.

A Striking Example of Factory Design Many Departments Coordinated for Maximum Efficiency of Production – An Establishment of Unique Interest.

OF ALL THE features of the great factory of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, Pa., the most striking is the coordination of the various elements of production there assembled according to a definite plan, thus making the works a unit and resulting in an astonishing efficiency of operation. Indeed, the keynote of the establishment is unity—concentration of departments and their arrangement with reference to the progress of work from one to another being carried practically to the point of assembling the whole industry under one enormous roof, covering about 23 acres of floor space and housing more than 6,000 operatives of all grades. It is not improper here to refer to the ability of Mr. George Westinghouse, the president of the company, who is responsible for the design of the works and the planning of the industrial operations carried on in them with a view to producing the best possible results.

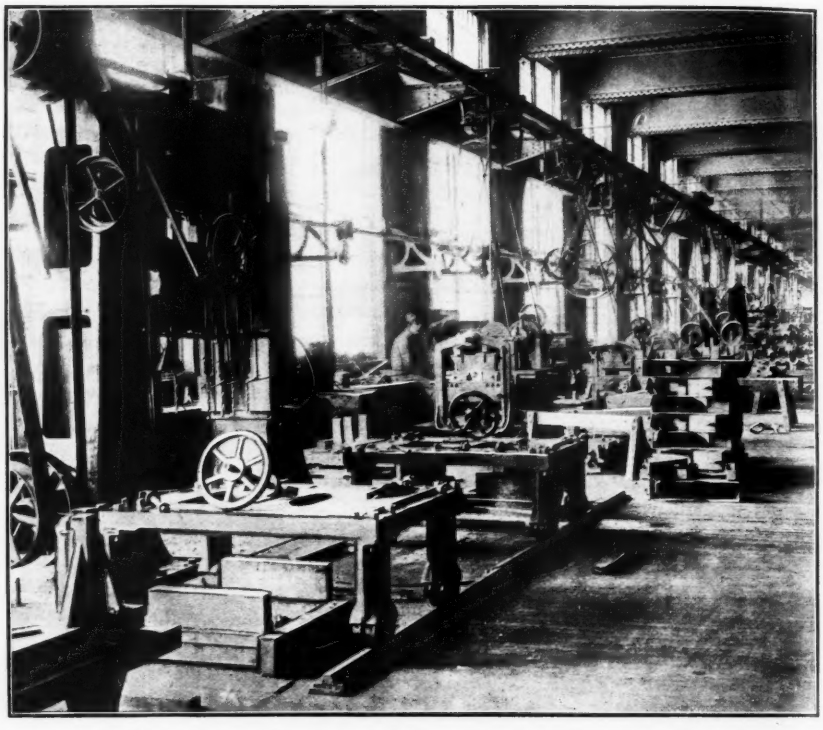
Reference to the accompanying illustration, showing a general view of the works, will make clear the arrangement of the various parts. The main shop building is 1,200 feet long, and is divided into four parallel bays, all being used as erecting shops. One of these bays is given over to the erection of street-car motors, one for dynamo machinery, both direct and alternating current, of sizes smaller than 100 horse-power, and the other two are for the construction of larger apparatus. The widths of the four aisles are, respectively, 80, 70, 80 and 65 feet, making the total width of the building about 300 feet. Each of the main bays is equipped throughout its entire length with runways for electric overhead cranes, the various cranes being from 40 to 46 feet above the floor and of capacities ranging from 10 to 50 tons. An excellent view of some of these cranes operating in one of the main bays is to be had from the illustrations herewith.

Alongside the machine shops, and, indeed, under the same roof with them, is a warehouse separated from the main building by a heavy fire wall. In this building, which is 1,200 by 76 feet in ground plan, is located the boiler and engine room. Back of this building, but connected with it by a covered way, is the sheet-iron department, including the shop for punching laminated material, this structure being two stories high, 76 feet wide and 420 feet long. Across a yard and parallel with this building is another of identical design used as a brass foundry. Between the two is the forge shop. Back of this is the storage house for oils, varnish, etc., these materials being stored in a specially constructed concrete cellar as a precaution against fire. Further on and in line with these buildings is a storage building for castings, the aisles of which are at right angles to those of the main shop. The three bays of this building are each 70 feet wide and 390 feet long, and each bay is equipped with an overhead electric crane. In the yard space



A General View of the East Pittsburg Works of the Westinghouse Electric & Manufacturing Company.

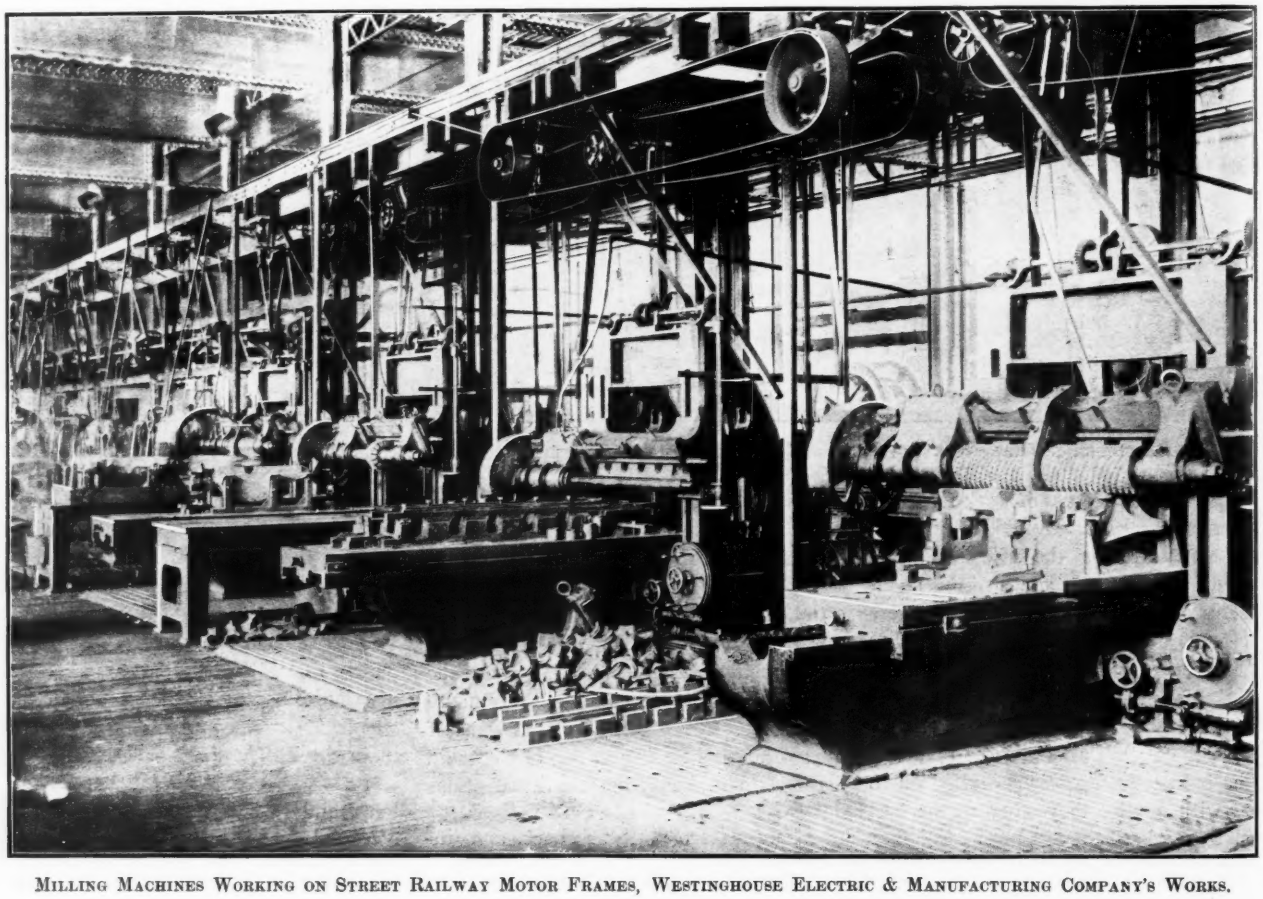
between the brass foundry and the punching shop is a large gantry crane, which is used, as are also the indoor cranes, in connection with a complete system of narrow-gauge railway track with which the shops and yards are provided, and in connection with sidings from the Pennsylvania Railroad which run the entire length of all of the principal bays of the building, one of them entering also the warehouse. Back of the storage shed is a carpenter shop, this being a one-story frame building. At the other end of the works is the handsome seven-story office building in which are located the executive and sales offices of the company, the draughting rooms, photographers, etc. All of the buildings are heated by the indirect system of radiation. Throughout electric power is used for all purposes. This will be more fully described below.



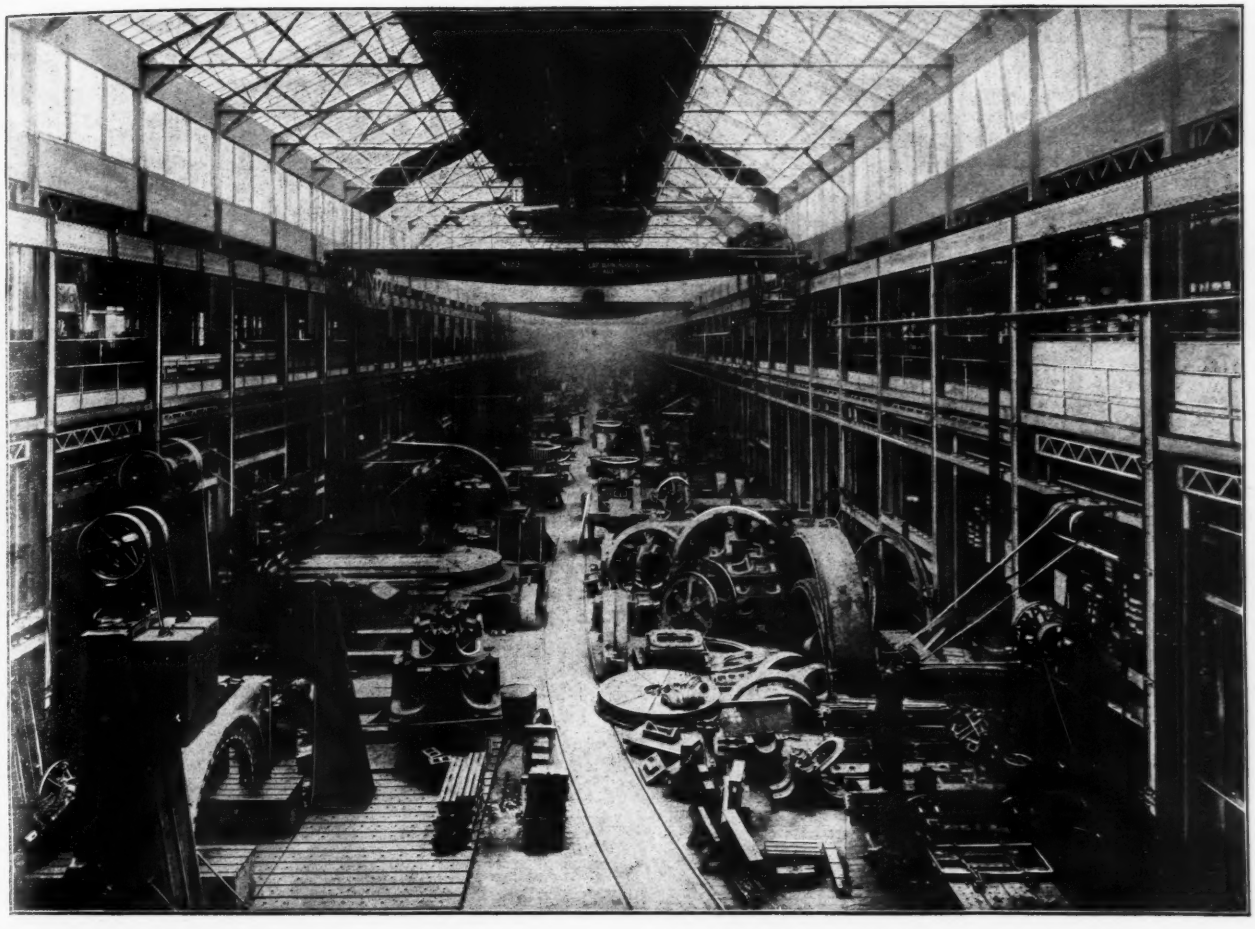
Multi-Spindle Drilling of Street Railway Motor Frames.

Entering the main machine shop and erecting room the visitor is struck with two peculiarities; nearly every tool is independently motor driven, and wherever it is possible each tool is portable. Indeed, each of the large shops and its contents can be regarded as a gigantic and complicated machine tool of which the various parts can be interchanged and shifted with readiness as desired, the overhead cranes bringing the work to the tool or taking the tool to the work, whichever may be more expedient and desirable in practice.

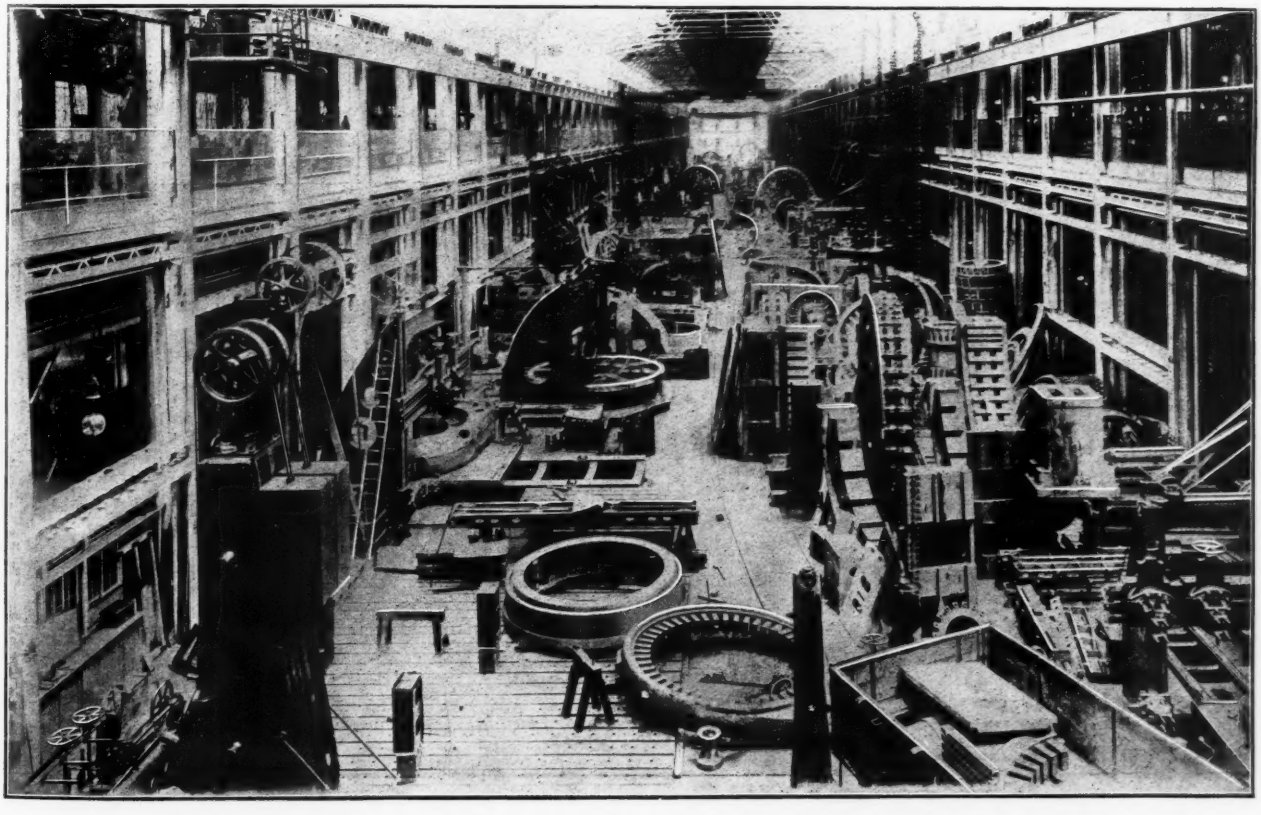
A number of processes of great interest are carried on in the main shop and some of these may be briefly mentioned here. In the aisle devoted to the manufacture of railway motors great use is made of



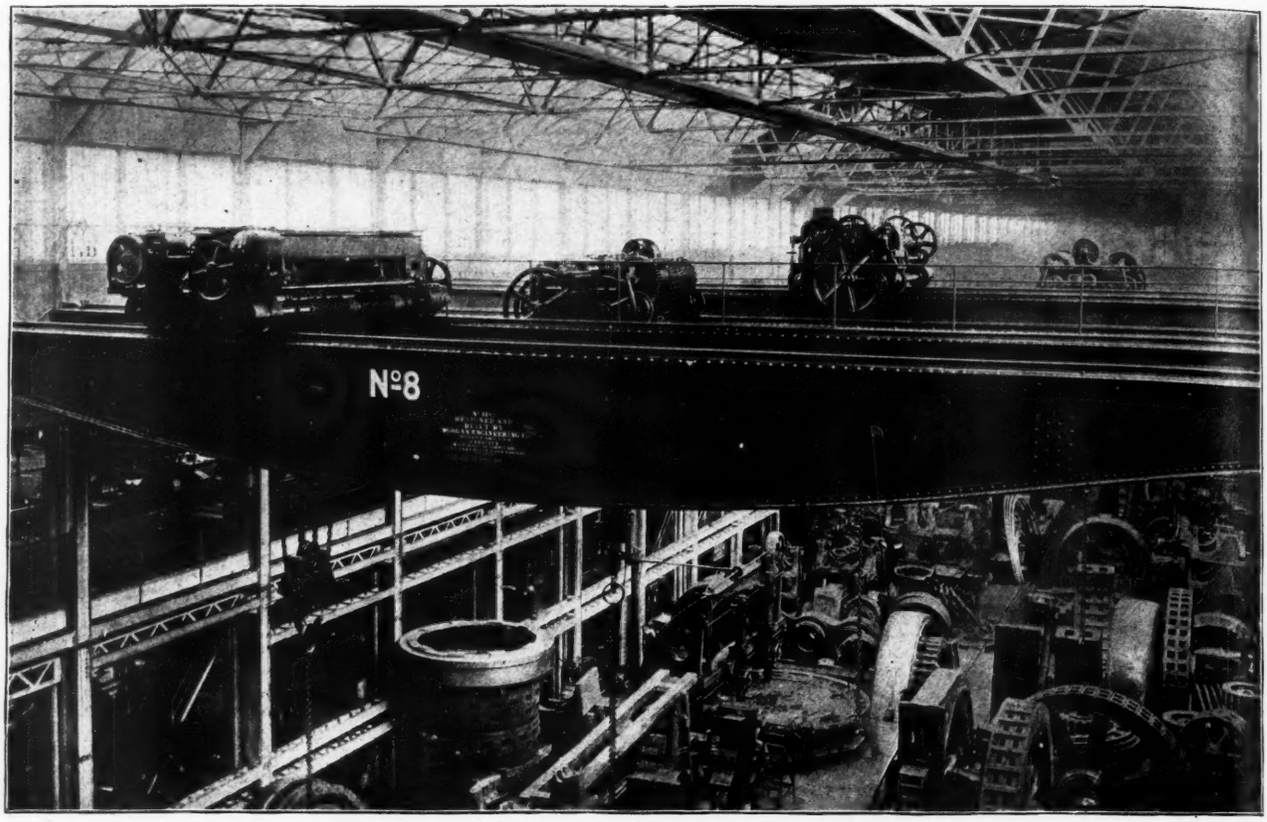
Milling Machines Working on Street Railway Motor Frames, Westinghouse Electric & Manufacturing Company's Works.



General View of One of the Erecting Bays in the Westinghouse Electric & Manufacturing Company's Works.



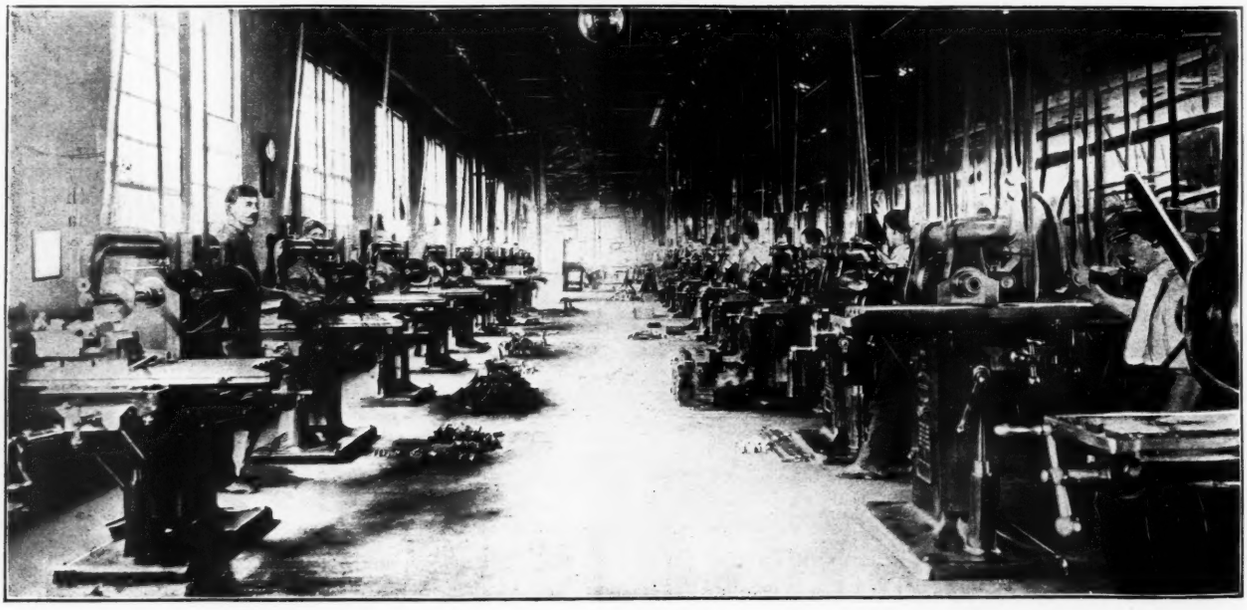
Main Erecting Bay in the Westinghouse Electric & Manufacturing Company's Works.



A Group of Electric Traveling Cranes in One of the Bays of the Westinghouse Electric & Manufacturing Company's Works

large and powerful milling machines, the equipment having been furnished mostly by the Ingersoll Milling Machine Company. One of the illustrations shows a group of these machines working on the frame castings of street-car motors. In the second stage of the work on these frames an ingenious system of gang drilling is in use, the frame itself being mounted on a turn-table which may easily be understood by reference to the illustration herewith. By the use of this method of construction great accuracy in the shaping of these pieces has been secured while the rapidity with which they are produced is astonishing.

The character of the work in the main assembling aisles may best be understood by reference to the illustrations. Electrical machinery has steadily grown more and more massive and some of the pieces that have to be handled to-day are of great size and weight. There is probably no more useful tool in the shops than the overhead cranes which permit the manipulation of these masses with the greatest ease. The cranes in use in these shops were built by the Morgan Engineering Company, of Alliance, Ohio, and are equipped throughout with Westing-



Group of Milling Machines for Work on Small Parts, Westinghouse Electric & Manufacturing Company's Works.

house motors. Current is supplied to these cranes at 550 volts, this being the pressure adopted for the general direct-current distribution through the factory. In all there are 31 overhead traveling cranes in the various bays of the building, many of the larger ones being equipped with auxiliary hoists of small capacity.

The equipment of machine tools in use in these shops is as fine probably as any in the world. Throughout it is evident that this is a manufacturing plant and that the tools installed are specially designed for the work of producing and duplicating the various parts of electrical machines. The visitor is apt to carry away with him an impression that the company's product has long passed the experimental stage, and that the plant is a factory in the truest sense of the word, in that it is making a staple and specific product and turning it out with great accuracy according to standards that have long been in use. This is entirely true as regards the manufacturing part of the works proper, but a large corps of engineers and electricians is constantly experimenting for the production of new types of apparatus and the perfection of old ones.

An excellent illustration of the way in which machine work and construction generally are carried on in these shops is found in section A, which is devoted to the manufacture of street railway motors. At one end of the long aisle the armature shafts and disks are received and assembled; immediately the cores go to the lathes and filing machines which are next in line, and thence to the winders. From this they pass to the small army of women operatives who connect the winding to the commutators. Meanwhile, at the other end of the shop the field castings have come in, gone through the milling and drilling processes described above, and received their field windings. The completed armature and the completed fields meet in the middle of the shop, where the motor is assembled and immediately transferred to the testing room near-by. During the whole operation no part of the machine has been moved over an unnecessary foot of space. All operations are arranged throughout the shop, wherever it is possible, with this same order of sequence in mind, so that as little time as possible is lost in the transit from one machine or operation to another.

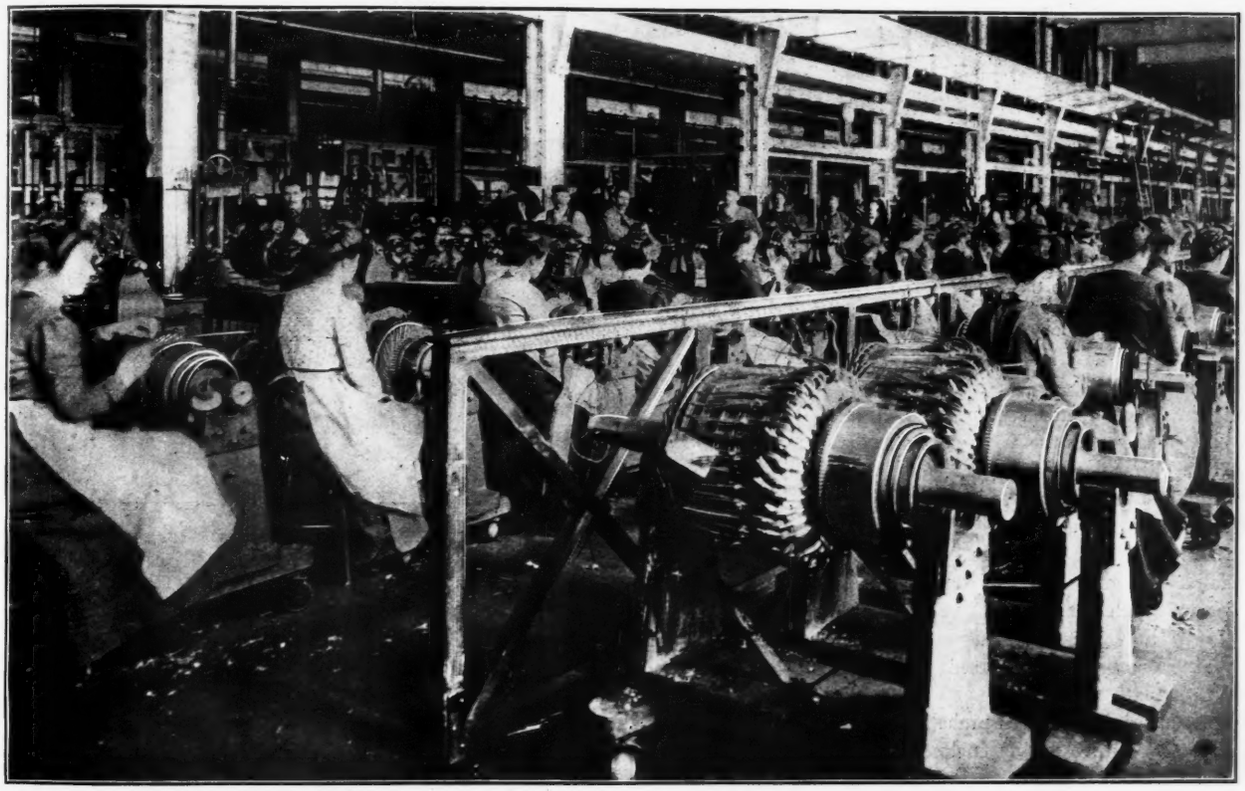
In the testing department of the machine shop, and also in the main bays, large sections of the floor are built of cast iron slotted to receive T-head bolts, somewhat like a planer bed, and upon these the heavy pieces of work and machines can be set up in proper relation to one another, or machines may be blocked upon them at short notice for testing purposes.

Throughout the works direct current at 550 volts is distributed for operating the cranes and a few direct-current motors, and two-phase current at 220 volts in each phase is distributed for working the large number of induction motors from which individual machines and groups of machines are driven. Long lines of shafting and counter-shafting are entirely avoided. In some cases short counter-shafts are used to drive groups of smaller tools.

Much work is done in galleries in the side bays, and to provide convenient passage from one to the other of these necessitated a bridge across one of the main machine shop aisles. On account of the cranes it was necessary to make this a drawbridge, which has been done, a motor being conveniently situated to fold the bridge up out of the way when it is desired to pass the crane with its load.

Taken altogether, the mechanical equipment of these shops is representative of the best American practice and reflects the highest credit upon its designer. It is not usual to find an industry of this magnitude located in buildings and employing machines and methods which have been designed entirely for its own use, and with a view to unity of operation, as is the case in this establishment. No better conception of the great machine shops can be had than by regarding them in their entirety as vast and complicated tools of great efficiency for the production of the manufactured products which the shops construct.

Two succeeding articles will take up in detail the various electrical and mechanical operations in these shops.



CONNECTING STREET RAILWAY ARMATURE TERMINALS.

THE DISTRIBUTION AND CONVERSION OF RECEIVED CURRENTS—III.

(Concluded.)

BY HENRY GORDON STOTT.

APPARATUS FOR STREET ARC LIGHTING.

At the present day if the problem of arc lighting for street purposes with 25-cycle three-phase current supply were to be placed before an engineer several methods of solution would suggest themselves in the following order: 1, rectifiers; 2, motor-generator sets, converting to 60 cycles constant potential with some form of transformer or reactive coil to regulate for constant current; 3, motor-generator set converting to constant continuous current; 4, motor generator set converting to constant alternating current with series transformers and condensers.

The full load efficiencies of the four systems with comparative investments and full power factors are approximately as follows:

1	2	3	4	
Rectifiers.	Motor-Generators. 60 Cyc'es.	Motor-Generators. Constant D. C.	Motor-Generators. Constant A. C.	
88	83.94	78.9	86.6	% Efficiency.
53	100	94	94	% Investment.
70	100	100	100	% Power Factor.

From the above table it will be seen that the rectifier leads in all respects save one, *viz.*, power factor (the power factors given are those of the 25-cycle end, the receiver power factor being of small importance), but in a system where the arc lighting forms a considerable portion of the system this is a serious feature, especially with generators not having good inherent regulation.

Owing to existing contracts with the city, the company was forced to adopt the third plan, but after the expiration of the present contract it will probably adopt the fourth plan, installing enclosed A. C. lamps.

The arc lighting equipment at present consists of 14 motor-generator sets, each set consisting of one 150-kilowatt revolving field type three-phase synchronous motor direct-coupled to two 125-light 9.6-ampere Brush arc generators, the motor being in the centre, with a generator on each end, coupled by means of a very simple but effective type of insulating coupling, consisting of four arms or spiders on the motor-shaft and a similar number on the generator, compressing spring rubber rolls three and one-half inches in diameter by four and three-quarter inches long between them.

These motors are started in a very simple manner. The switchboard panel, shown in Fig. 10, controlling each motor has mounted on it one ammeter, one double-pole field switch with discharge resistance as shown in sketch, Fig. 11, three single-pole double throw knife switches and a rheostat. The fuse base is mounted on the back. Fastened to the wall behind each panel are the reactive coils for starting the motor.

To start the motor the three single-pole switches are thrown down, thus connecting the motor armature to the bus-bars through the reactive coils; the motor comes up to full speed in about 50 seconds, taking at the start about 150 per cent full-load current. The time of attaining synchronism is determined by touching the blades of the field switch connected to the revolving fields on the discharge resistance clips and noting if any spark occurs. In the absence of any, the field switch is closed, exciting the fields and the single-pole double-throw switches turned up one at a time (the motor running single-phase meanwhile).

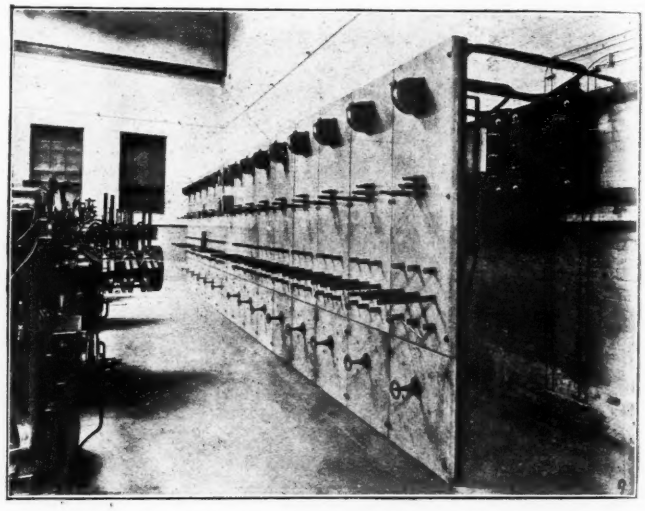


FIG. 10.—SWITCHBOARD PANEL.

The spark at the discharge resistance terminals is of course due to the difference in frequency or slip between the impressed frequency and that due to the speed of the motor. At the start this gives about 2,200 volts, dying down in inverse ratio to the speed attained, to zero, at synchronism.

550-VOLT POWER SERVICE.

The 550-volt power service is supplied from rotary converters (Fig. 12), in the usual way, calling for no comment beyond the method of starting from the A. C. end which is done in exactly the same way as in the synchronous motors; the fields being stationary, a multiple blade switch is mounted on the frame of the machine to isolate each field winding, and thus break up the induced electro-motive force at starting.

60-CYCLE SYSTEM.

Three 500-kilowatt three-phase synchronous revolving field type motors direct-connected to 500-kilowatt revolving field 2,200-volt quarter-phase generators, furnish the current for this system. The feeders are connected to double-throw oil switches, so that they can be thrown from one phase to the other to balance up the load, a further control of the voltage being obtained by means of regulators on each phase. Some rather unusual problems presented themselves in synchronizing these 60-cycle generators. The motors having eight poles and the generators 20, it is evident from the sketch, Fig. 13, that only every fifth pole of the motor will be the proper point to lock at. At first it was supposed that by opening the field switch on the motor that it would slip a pole when the generator field was excited, and the whole iron losses acting as load, but the voltmeter showing the resultant voltage between the bus-bars and the ingoing generator refused to move. The synchronous motor was too good a hysteresis and reaction motor, but the solution was found in putting in a reversing field switch on the motor, thus causing it to slip a pole on each reversal. The inner circle, shown in Fig. 13, represents the motor poles, and the outer the generator. If the generator carrying load has its poles in the position 1, 1, at the moment the field switch on the motor about to go into service is closed, and the latter locks with 1, 1, in the position of 4, it is evident that we must reverse the motor fields several times in order to make it slip back to position 3, then 2, and finally 1. Whilst the position 3, 6, has a similar relation to the generator pole, to that of 1, 1, yet the polarity is reversed on the generator so that unless we reverse the generator field also, the motor must be made to slip to position 1, 1. Another peculiar feature was that supposing the bus-bar voltage and that of the ingoing machine to be the same, and the machines apparently in phase, if thrown together the ingoing machine would not

take more than a small fraction of the load, and no change of field strength of either motor or generator had any effect, beyond making the generator carry idle current.

We have here the peculiar combination of double synchronism, with mechanical connection besides, so that either machine may act as motor or generator according to conditions. The explanation is as follows:

The motor carrying the load sags behind a few degrees of phase, carrying with it the generator, but the latter having 2.5 times the number of poles of the motor, any sag of the motor is multiplied by 2.5, thus causing a difference of phase between the loaded generator and the unloaded one great enough to render division of load impossible. Increasing the field strength of the light generator merely results, under these conditions, in the unloaded generator supplying idle cross current out

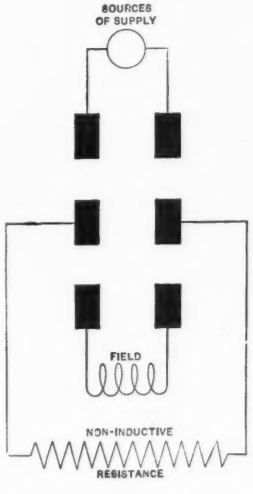


FIG. 11.—CIRCUITS OF SWITCH SHOWN IN FIG. 10.

of phase with the bus-bar current, and therefore not putting load on its own motor. Manipulation of the motor field rheostats can evidently accomplish nothing to bring the generators into phase.

The solution is a rather startling one, and is found in the use of oscillating currents. The ingoing generator is excited to such a degree that the resultant voltage from it and the bus-bars is equal to the latter; this means at half load on one, and the other light, an increase of four per cent in voltage, indicating a phase angle difference of about 22.5 in the generators and nine degrees sag in the motor. The motor fields are weakened and the unloaded generator thrown on the bus-bars. Owing to the difference of voltage and phase the sudden closing of the circuit establishes strong oscillatory currents between the generators; these are transmitted mechanically to the motors and repeated, the amplitude gradually decreasing from a maximum value of 100 per cent full-load current to zero as the equilibrium of the circuit is established. The whole time, from the moment of putting the unloaded generator into multiple to the disappearance of the oscillations, is usually about 45 seconds, during which the field strengths of the generators and motors are rapidly equalized, and the load will be found to be perfectly divided between the two generators, the mechanical oscillations having resulted in the only stable equilibrium possible under the conditions.

EXCITERS.

Before the installing of the storage battery it was necessary to have some quick means of getting continuous current, to determine the polarity of the rotary converters and energize the fields of the synchronous motors in case of a shut-down on the power circuits, and for this purpose two exciter sets, consisting of 30-horse-power induction motors direct-connected to 20-kilowatt 125-volt continuous-current generators, were installed. Since the installation of the battery, all the exciting current is taken from it during the period of heavy load, for two reasons; first, to reduce the peak load; second, to automatically maintain an almost constant power factor of 98 per cent leading, on the total load of the plant, due to the Edison load increasing (and bus-bar pressure increasing correspondingly) simultaneously with the other station load and thus giving increased constant electro-motive force in the motors.

EDISON SYSTEM.

There are evidently two ways of converting three-phase 25-cycle current into 120 to 150-volt continuous current, one being by means of transformers with rotary converters and the other with motor-generator sets.

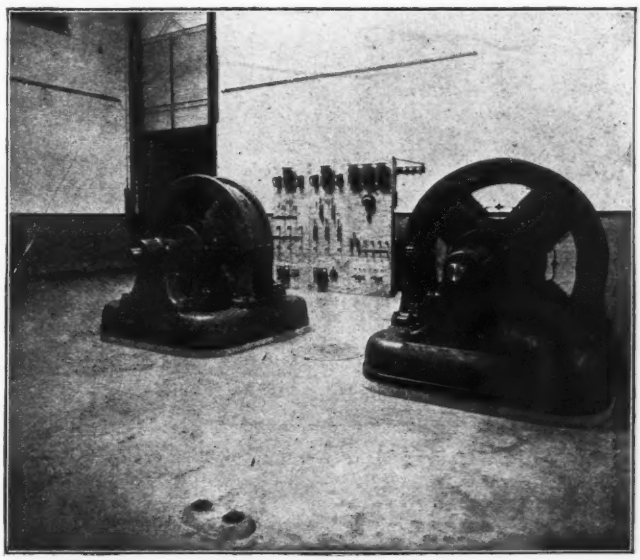


FIG. 12.—ROTARY CONVERTERS.

A comparison of the net efficiency of both systems for 200-kilowatt units is given in the following table, the rotary including in its circuit some form of regulators capable of varying the voltage 25 per cent:

	Motor-Generator.	Transformers and Rotaries.	Difference.
Full load.....	87.40	89.87	2.47
Three-quarter load.	85.54	88.70	3.16
Half load.....	81.42	84.90	3.48

Owing to the additional regulating ap-

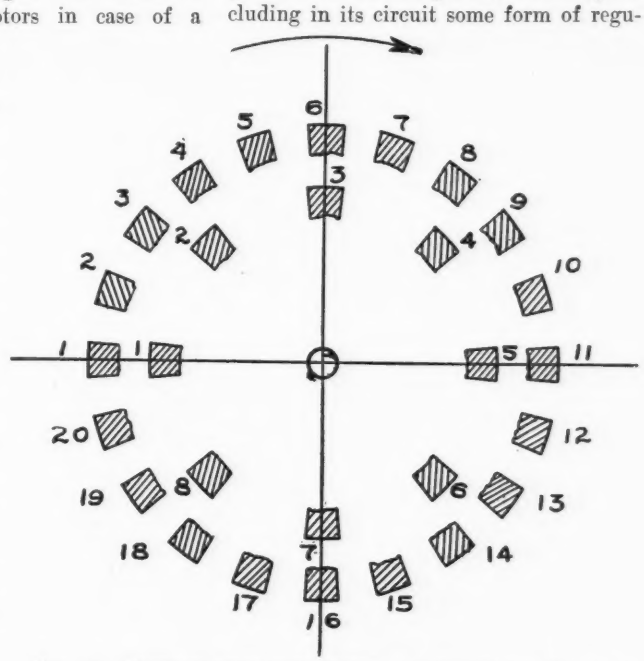


FIG. 13.—DIAGRAM INDICATING MOTOR AND GENERATOR POLES.

paratus necessary with the rotaries, the first cost in either case is practically the same.

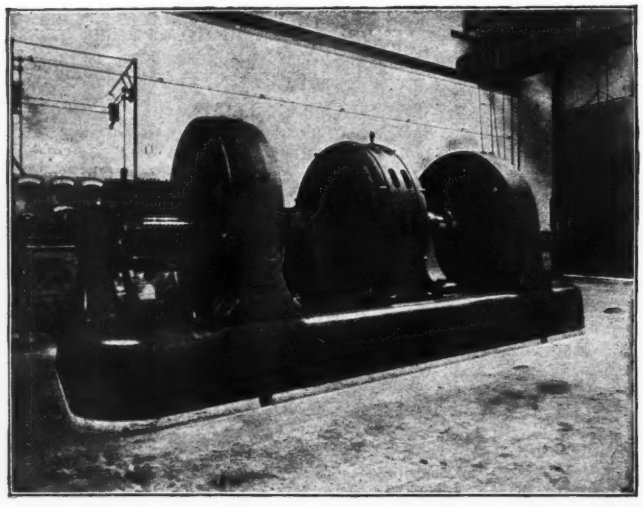


FIG. 14.—DIRECT-CONNECTED MOTOR-GENERATOR SET.

From the above efficiencies, rotaries would seem to be indicated as the best choice, but in an extensive power transmission scheme where nearly 50 per cent of the load is used for railroad purposes, and the generators have a comparatively poor inherent regulation to enable them to withstand safely severe short-circuits on the lines, rotaries have had to be abandoned for this service, every fluctuation of the line potential being reproduced on the direct-current side. Two 100-kilowatt rotaries were installed, but additions have been made to the system only in motor-generator sets, two of which are installed, the first of which is a direct-connected set consisting of a 425-kilowatt motor coupled to two 200-kilowatt generators (Fig. 14), having a very wide range of voltage to permit of charging the battery direct without the intermediary of a booster; the second, now being installed, is an 850-kilowatt motor direct coupled to two 400-kilowatt generators.

A 150-kilowatt booster set, consisting of a synchronous motor coupled to two direct-current boosters, is used for charging purposes, and for carrying long feeders. The storage battery has a capacity for one and one-half hours of 6,000 amperes at 150 volts (Fig. 16), there being 75 cells on each side of the system with two 20-point end cell switches (Fig. 15), on each side to give control of the pressure under varying load.

A peculiar point observed is that a motor-generator set and rotaries operating in multiple on the direct-current side, tend to regulate one another, with varying speed, for constant potential. The rotary being practically independent of speed, a fall of speed or frequency on a transmission system having a large amount of inductance reduces the reactance, and a rise in speed increases the latter so that but for changes in the impressed voltage the rotary should give the best results on a system driven from water power in which the governors must of necessity be sluggish. The motor-generator, on the other hand, is independent of changes in impressed voltage, but sensitive, especially with under-saturated fields, to change of speed.

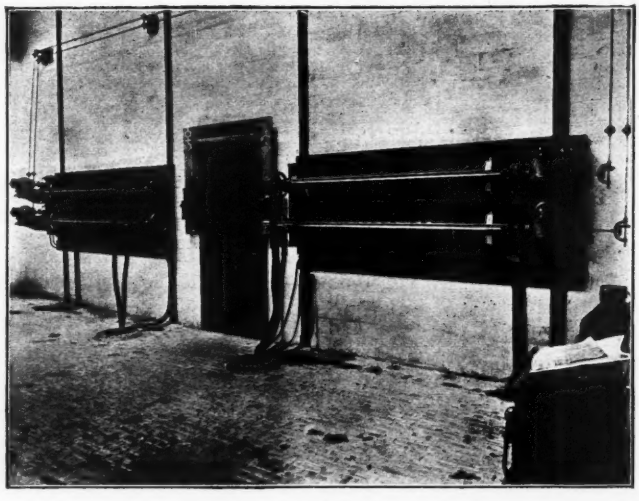


FIG. 15.—TWENTY-POINT END CELL SWITCHES.

In concluding this paper the author wishes to express his obligations to Mr. P. F. Sellers, of the Cataract Power and Conduit Company, for outline drawings, and to Mr. G. A. Harvey, of the General Electric Company, for photographs.

Much matter which could, under a strict construction of the title, have been put in has been left out, and matter which, in the author's opinion, is more interesting and practical substituted.

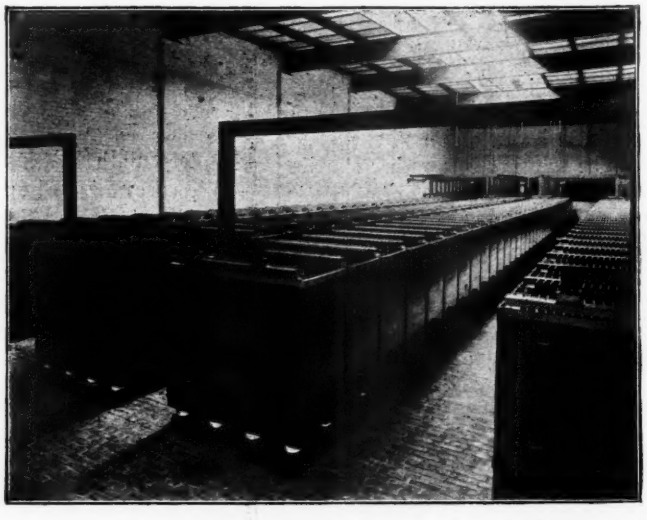


FIG. 16.—STORAGE BATTERY, 9,000 AMPERE-HOURS CAPACITY.

LEGAL NOTES.

A rule of a street railway company requiring all colored persons to occupy front seats and white passengers the back seats is held in Bowie *vs.* Birmingham R. & E. Co. (Ala.) 50 L. R. A. 632, to be a reasonable regulation.

A voluntary settlement by an injured person with the party causing the injury is held, in Southern Bell Teleph. & Teleg. Co. *vs.* Cassin (Ga.) 50 L. R. A. 694, to preclude an action for his death by his wife or child under a statute giving a remedy for the homicide of a husband or father.

A contract by a city with a railway company to maintain for all future time a bridge constructed to restore a public thoroughfare used by the railroad company to its former condition of usefulness is held, in State *ex rel.* St. Paul *vs.* Minnesota Transfer R. Co. (Minn.) 50 L. R. A. 656, to be *ultra vires*, contrary to public policy, and void.

The duty of a railway company under a contract with a city to keep its tracks in a suitable and safe condition for those who pass over the streets is held, in Kansas City *vs.* Orr (Kan.) 50 L. R. A. 783, not to relieve the city from its duty to the public to keep its streets in reasonably safe condition, nor to relieve it from liability for the consequences of its negligence in that respect.

The Pan-American Exposition.

Its General Features and Details of Electrical Interest. In Two Parts.

Part II.

WHILE electric lighting is the principal feature of the Pan-American Exposition, and the one that seems most likely to make a deep and abiding impression upon the casual visitor, yet it is by no means the only way in which electricity is utilized upon the grounds for various purposes both esthetic and utilitarian. In the first place, the power service of all kinds about the grounds and buildings is electrical, as, indeed, it must be in these days when other forms of prime movers are out of date and out of fashion.

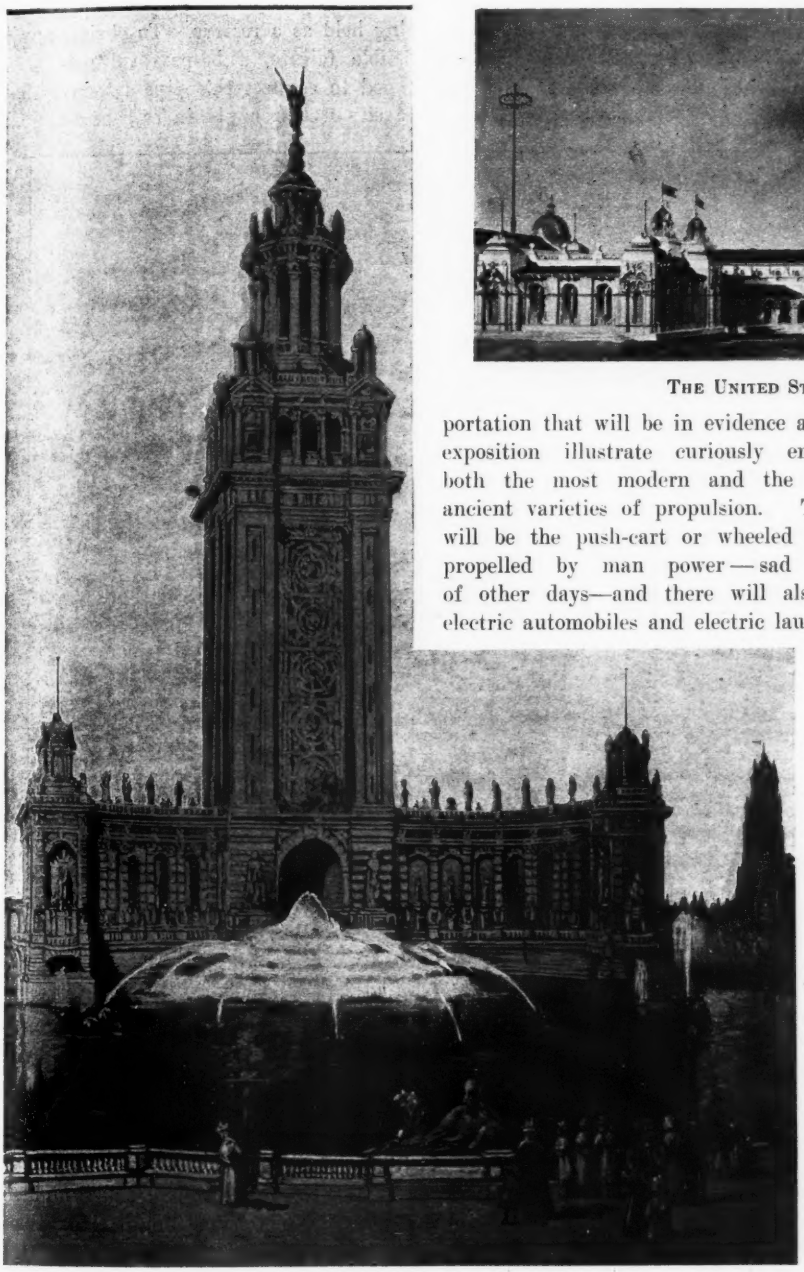
The three varieties of intra-mural transportation that will be in evidence at the exposition illustrate curiously enough both the most modern and the most ancient varieties of propulsion. There will be the push-cart or wheeled chair propelled by man power — sad relic of other days—and there will also be electric automobiles and electric launches on the lake and lagoons. The automobiles will ply about the roads of the exposition, going from point to point of interest, and it is expected that large numbers of visitors will use them, as well as the launches, as a means of transportation.

Transportation facilities, however, are by no means so necessary on these grounds as they were in the vast areas of Chicago and the scattered suburbs of the Paris Exposition of last year. While the main part of the Pan-American Exposition is larger than that of any international fair hitherto held, yet the total compass of its grounds has wisely been made less than that of preceding expositions, and the design and grouping of the buildings are so compact that it is believed much less exertion will be required from the visitor than has previously been the case.

A feature which should not be forgotten in speaking of the grounds and buildings is the treatment of interior spaces in conformity with the architectural plan of the whole exposition. As a general thing in the past exposition buildings have been mere shams, hollow barnlike structures, elaborately decorated on the outside, but revealing the bareness of lath and plaster framework to the eyes of all beholders within. The interior decorations of the buildings at Buffalo have been studied with the same felicitous care that has been applied to the exterior effects. Various courts and loggia in the interior of the buildings, or those made by groups of surrounding buildings, have given occasion for the display of excellent taste on the part of architects, gardeners and decorators.

Of the exhibits themselves it is too early yet to attempt any complete description. The general plan of the Electricity building comprises the grouping of the heavy exhibits at the western end, while the lighter ones, such as telephones and measuring apparatus, are grouped at the

THE UNITED STATES GOVERNMENT BUILDING.



SKETCH OF THE ELECTRIC TOWER SHOWING THE ILLUMINATED FOUNTAINS.

eastern end of the building. The numerous exhibits themselves are in most cases elaborately and handsomely finished, but mention of these in detail must be deferred for future articles.

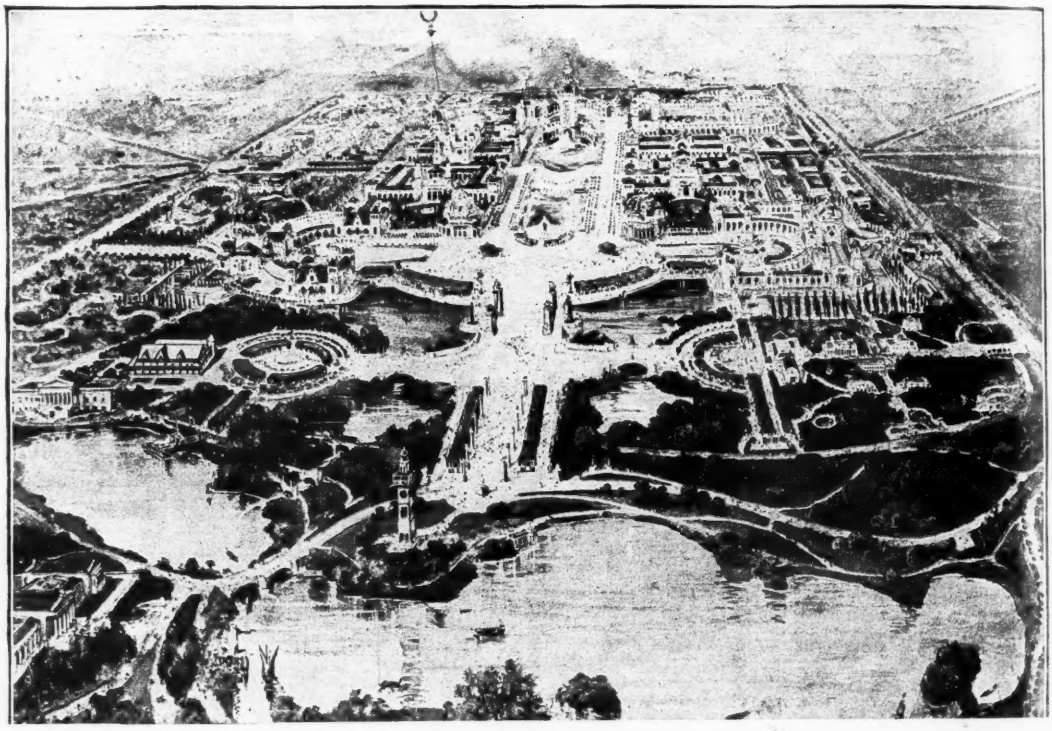
In the Electricity building the first impression of the visitor is that of space and lightness. The daylight illumination of the building, thanks to its excellent design, is remarkably good, while its night illumination is extremely brilliant, especially so on account of the large number of electric signs used by the exhibitors, as well as the numerous arc lamps hung from the lofty ceiling. The interior is finished in drapings of white fabric, relieved by festoons and rosettes of light-colored material, the whole being very pleasing and satisfying. Many of the exhibitors occupy handsome booths, and some of these structures, which will be described in later issues, are exceedingly beautiful.

Returning now to the electrical illumination and decoration of the exposition as a whole, the roadways and canals are lighted both by arc lights and by clusters of incandescent lamps grouped at the top of ornamental columns, one of which is illustrated in the accompanying engraving. In the north bay of the lake is an electric fountain. The shores of this bay rise about 30 feet and are sloping and well-wooded, furnishing a sort of natural amphitheatre in which the display of the fountain can be witnessed by large crowds of people in comfort. The fountain is located on an island built in the centre of the bay about 160 by 80 feet in size. The island rises about 10 feet above the level of the water, and its shores being covered with irregular rock masses its daylight appearance is exceedingly beautiful without offering any suggestion of the concealed mechanism of the fountain. Underneath the island is a chamber containing powerful pumps operated by electric motors, and the arc lights and projectors for producing the light and color effects.

The fountain is arranged with nine different pipe systems controlled by operating levers in the underground chamber, making about 150 combinations possible. There are, in all, over 100 jets or orifices in the fountain, 22 of them being provided with projector lights. The central jet will throw a one-and-one-half-inch solid stream 250 feet high. In addition there are a large variety of jets and arrangements of nozzles permitting of all the displays usual in electric fountains of the largest and most elaborate character. Twenty-two arc projector lamps are used in the display, each consuming 20 amperes of current. Water to the amount of 3,600 gallons per minute is furnished by two pumps, made by the Roots company, one delivering 3,000 gallons per minute at 50 pounds pressure, and the other 600 gallons per minute at 150 pounds pressure. The smaller pump is intended to supply the central geyser jet. Both pumps are driven through a counter-shaft from a 500-volt direct-current Westinghouse motor fed from the general motor supply circuit of the grounds, while current for operating the lamps is obtained from a motor-generator set forming part of an exhibit and located in a booth on the west bank of the bay. The projectors used were manufactured by the Charles J. Bogue Company. It is believed that this fountain is the largest and most elaborate electric fountain ever constructed.

A feature that has been carefully worked out at the exposition is fire protection. In a fireproof building at the northwest corner of the grounds (forming part of the service power plant) are three Snow duplex underwriters' pumps, each of which has a capacity of 750 gallons per minute. Automatic regulating valves maintain a constant pressure upon the mains, laid throughout the grounds, of 150 pounds per square inch, which can immediately be raised to 250 pounds upon receipt of a fire-alarm signal. It is believed that two of these pumps are of ample capacity for any emergency, one being held as a reserve. To obviate any possible failure, a by-pass valve is arranged to connect this pipe system with the city water supply in case of failure of the pumps. About 30 electric fire-alarm boxes are established in the various buildings and on the grounds, while 17 two-way hydrants about the exposition are connected with the city service, and 77 hydrants to the exposition plants. On the outside of the grounds and adjacent to them are 16 other hydrants connected with the city system. All of these are indicated by red lamps which burn all night.

In addition to these protections the principal buildings are provided with standpipes two and one-half inches in diameter, 12 of these being located in the Electricity building. In this building also, pipes are run to the roofs, with lengths of hose on automatic valve-reels connected to them. Fire alarms are provided in all buildings, while there are three steam fire engines located in houses



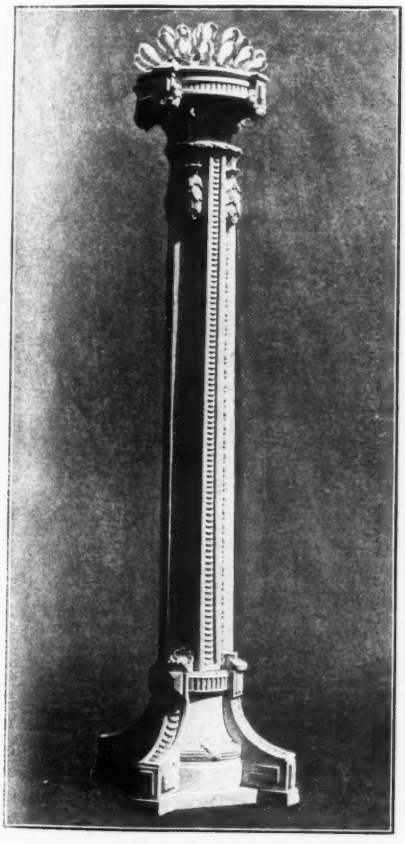
A Bird's-Eye View of the Central Part of the Pan-American Exposition.

on the grounds, as well as chemical extinguishing apparatus.

It is probable that no other exposition ever had such a side attraction as has this one at Buffalo. It is only 27 miles to Niagara Falls, whence comes the bulk of the power for lighting the grounds. The electrical industries that are gathered together at the Falls are too well known to require further description here, but it is well to note that nearly all of them keep open house for the visitor, and that, taken together, they form an electrical exhibit of almost unparalleled magnitude.

American Tramway System in New Zealand.

Consular reports from Auckland, New Zealand, state that for more than three years the Auckland authorities have discussed the advisability of introducing an electric



One of the Lamp Posts in the Court of Fountains at the Pan-American Exposition.

tramway system in that city. Several contracts were granted to local firms and London contractors, but for some inexplicable reason the change was not made, and now a New York company has arranged to build the road, which will cost, complete, about $1,000,000. Rails, cars and other materials will be brought from America, as well as the men necessary to equip the line and put it in operation.

Death by Electricity.

[*From the Washington, D. C., Post*]

The controversy over electrocution—whether it is or is not a more merciful death than hanging—has recently broken out again with something of its former intensity. The Electrical Review has expressed the opinion that electrocution is "inhuman torture," and it calls for a commission of experts to examine the subject. As the national government is very much in the commission business and has occasion now and then to kill a wicked citizen, the Review's suggestion might meet with favor if presented to Congress. At any rate, such a commission would scarcely be more costly and less profitable than some commissions which have been created by unasked-for and unnecessary acts of Congress.

The *American Inventor,* of this city, takes no stock in the "inhuman torture" theory, but second's the Review's proposition for a commission. The *Inventor* recently said: "Let us have the light of a few facts in regard to the subject, or silence." Thereupon Mr. A. B. Brooks, electrician, of Cañon Ferry, Mont., sent to our local contemporary "a few facts" from his own experience. He accidentally got hold of a grounded telephone wire. He says:

"The duration of the shock could not have been more than a couple of seconds. A man riding by on a wheel going at a good pace had only time to pass about 30 yards beyond me when the operator got through talking and opened the switch, yet I could see every spoke in that bicycle wheel, and it barely seemed to me to be turning. I could plainly feel every reversal of the current, and these reversals occur at the rate of 60 complete cycles per second. It is this intense activity of the brain to electrical impressions that makes an instant of electrical shock seem hours to the sufferer. Of course, it is impossible to know what a man dying of strangulation suffers, but I will positively affirm that any man who has ever had a severe shock will prefer anything to another. The fact that my own case was not fatal does not alter my opinion that death by the electric chair is most painful. The sensations of pain and the elongation of the sense of consciousness of time seem to increase in direct proportion to the violence of the shock. If I suffered what seemed to me hours with a current which did not kill, why may not a man suffer with a stronger shock between the time of its first application and his final loss of consciousness?"

This is a question which, we suppose, must remain indefinitely in the domain of speculation. Positive knowledge on the subject is practically unobtainable. The contention that death in the electric chair is instantaneous—or that the shock instantly destroys sensation—may be true, but is it proved? It is a well-known fact that a dream covering years of time and a great variety of experiences may occur in a few seconds. May not the agony of a fatal electric shock be similarly prolonged?

The Telephone in Surgery.

The war in South Africa has led to the use of the telephone in surgery. A Mauser bullet had entered a soldier's back, pierced the stomach and lodged right in front of the latter. When breathing deeply, the patient suffered great pain, and it was found that the removal of the projectile

Mr. George F. Sever.
Superintendent of Electrical Exhibits at the Pan-American Exposition.

offered great difficulty. As in the operation pincers had to be employed, the telephone probe was selected for that purpose, the special utility of that instrument being based on the fact that when the pincer-like ends of the probe close over a metal body a noise is heard in the telephone. The surgeon soon got hold of what he thought was the bullet, but it resisted his attempts to draw it out. His assistant, who held the telephone, could hear no noise in it, and it was therefore clear that the bullet had not yet been reached. Then the probe was pushed in further, the telephone gave its note of warning and the removal of the projectile was easily effected.

In a case where the bullet had entered the shoulder, the probe first got hold of what seemed to be the projectile, but afterward proved to be a tendon. Only the failure of the telephone to emit any sound deterred the surgeon from giving a vigorous pull and thus doing permanent injury.

A New Cable.

The Western Union Telegraph Company is said to have received a despatch stating that the new cable between Porthcurno, Cornwall, and St. Vincent, C. V. I., has been opened for traffic, thus completing the new cable route between South Africa and Great Britain.

News from Great Britain.

From Our Special Correspondent.

BY THE TIME this is printed the International Exhibition at Glasgow will have been opened to the public. The present, therefore, is opportune for giving all that remains to be said of the system of lighting and power. The generating station is situated at the southwest end of the Machinery Hall, and, as stated last month, consists of 12 sets of combined steam engines and dynamos giving a total output of 4,176 electrical horse-power. The main switchboard consists of 15 panels of enameled and polished slate slabs, and measures 31 feet 9 inches in length by 7 feet high. Upon these slabs are mounted the regulating, controlling and recording gears. Each dynamo is connected to the bus-bars of the main switchboard through an automatic magnetic circuit break switch, ampere-meter, shunt regulator and double-pole fuses. The main station feeds seven distributing stations, and from six of these all the arc and incandescent lighting will be controlled. Separate switch and fuseboards for the arc and incandescent circuits have been erected. Brockie-Pell 10-ampere arcs have been decided upon, which will be run 10 in series on a 500-volt system for the main buildings, and five in series on a 250-volt system for other parts of the exhibition. The wiring of these arc lamps is so arranged that every alternate lamp is connected to a different circuit, so that should a particular circuit or lamp get out of order, the lighting of that portion of the buildings will not be seriously affected.

The main cables have been supplied and laid by the British Insulated Wire Company, and are low-tension, triple-concentric, insulated with impregnated paper and lead covered. There are seven of these cables, each with a sectional area of 0.25 square inch, their total length being about 4,000 yards.

On a specially erected tower is erected a huge searchlight manufactured by the British Schuckert Electric Company, for which current will be taken from the Glasgow Corporation electric mains. This is fitted with parabolic glass mirrors 150 centimetres in diameter, the whole apparatus being regulated by two small electric motors. Its weight is nearly one and one-half tons. In addition to these two motors there will be something like 150 others, ranging from one-quarter to 150 horse-power, for working the exhibits. The searchlight was originally intended to be fixed on the roof of the Grand Concert Hall.

A pleasing reality to all who have the electric traction industry at heart in the United Kingdom, is the yearly increasing number of bills submitted to Parliament for powers to construct tramways and light railways all over the country. But still more productive of a sense of pleasure is the broad-mindedness with which the committees of both Houses are now disposed to view these proposals. In the early days, unless a scheme was of an exceptional nature, the odds were decidedly against its realization, but nowadays, provided a promoter can show a modicum of benefit to the public at large by the accomplishment of what is desired, his proposal will be well considered before refusal. No doubt the increased popularity of electricity for all purposes on the Continent and in America, which is being continually forced upon the British public (sometimes in an alarmingly ignorant manner) by the daily press, has a lot to do with this state of affairs, but, at the same time, it is not always that we have had ministers willing to be convinced by facts. That this opinion as to the favor with which electric schemes are now viewed is shared by greater authorities is demonstrated by the resuscitation of the bill for an extra high-speed monorail electric line between Liverpool and Manchester which was "stopped" last year chiefly because the House of Commons Committee failed to perceive the efficacy of the proposed braking arrangements. Mr. Behr, however, who was last year supported by Sir W. H. Preece, K. C. B., has now made some modifications which bring his idea more into line with the committee's requirements, and the bill seems to stand a good chance of getting through. The line is on the principle of the Barmen-Elberfeld railway in Germany, which was opened last year, and the proposed speed is 120 miles an hour.

It was announced at a meeting of the Thames Iron Works and Shipbuilding Company just recently that their electrical engineering department has arranged to combine with Messrs. Siemens Brothers & Company, Messrs. Mather & Platt and the Brush Electrical Engineering Company. Such a combination, it is hoped, will enable a more effective opposition to be made to the competition of American combinations and German syndicates. Seeing that only quite lately the Brush company joined hands with the British Electric Traction Company, this latter move should do much to keep the home electrical trade in British hands.

An echo of London's erstwhile unhappy electric cab service is a petition for the compulsory winding up of the London Electric Cab Company. On the hearing of the petition it was stated that an endeavor to sell the licenses, which form the assets of the company, has resulted in an offer of £25.

At last can London boast of an electric tramcar service. After many trials and tribulations the London United Tramways Company has been permitted to work its "trolley" lines, and cars commenced running in time to catch the Easter holiday traffic. Such was the crowded state of this traffic that the cars were but a few feet behind each other all day. Fifty-two cars are at present in use and on the opening days 100,000 passengers were carried. An interesting sequel to the opening of these lines is the decision to remove all the magnetic instruments from the Kew Observatory to a spot where they will be less liable to disturbance from electric traction stray currents. As yet, however, the National Physical Laboratory Committee has made no definite arrangements as to where they will go.

A commencement has been made to convert the only accumulator tramway line that ever ran for any length of time in England to the overhead trolley system. I refer to Birmingham, which company made a profit of some £70,000 during 1900. Since October last year, however, the work of conversion has been going on and some portion of the reconstructed system is expected to be opened shortly.

The daily press regularly finds something to say as to the electrical equipment of the "Circle" steam line in London, and Mr. Yerkes's name has been made free use of in connection therewith. What the true state of affairs is I do not pretend to guess, but the fact remains that the Metropolitan Railway Company—which is the company in question—has deposited a bill asking for an extension of time in which to convert to electric traction, and seeking powers in the meantime for the construction of additional "blow-holes" for getting rid of the sulphurous smoke from

the steam locomotives. This hardly suggests a "near future" move in the direction of electric traction.

Apropos of my remark a little time back, that some extensive commercial application ought to be made of Marconi's wireless telegraphy, it is encouraging to learn that a Marconi station is being erected on the Irish coast near the Fastnet for the purpose of reporting vessels fitted with wireless apparatus. The Fastnet consists of a group of very dangerous rocks upon which is built a lighthouse, and for years a satisfactory system of signalling between this and the mainland has been a nightmare to those directly concerned. Cable communication has been utilized up to the present, but so frequently has the cable been broken, that it has often been impossible to summon help from the shore in case of wreck. With the use of wireless telegraphy, however, a ship can signal direct to the Marconi station without the assistance of the intermediary lighthouse. The Postmaster-General, also, has arranged to receive a deputation of the directors of the Marconi Company this week, and the company hopes shortly to be in a position to inform shipping companies upon what terms their boats may, when fitted with wireless telegraphic apparatus, communicate with the shore station.

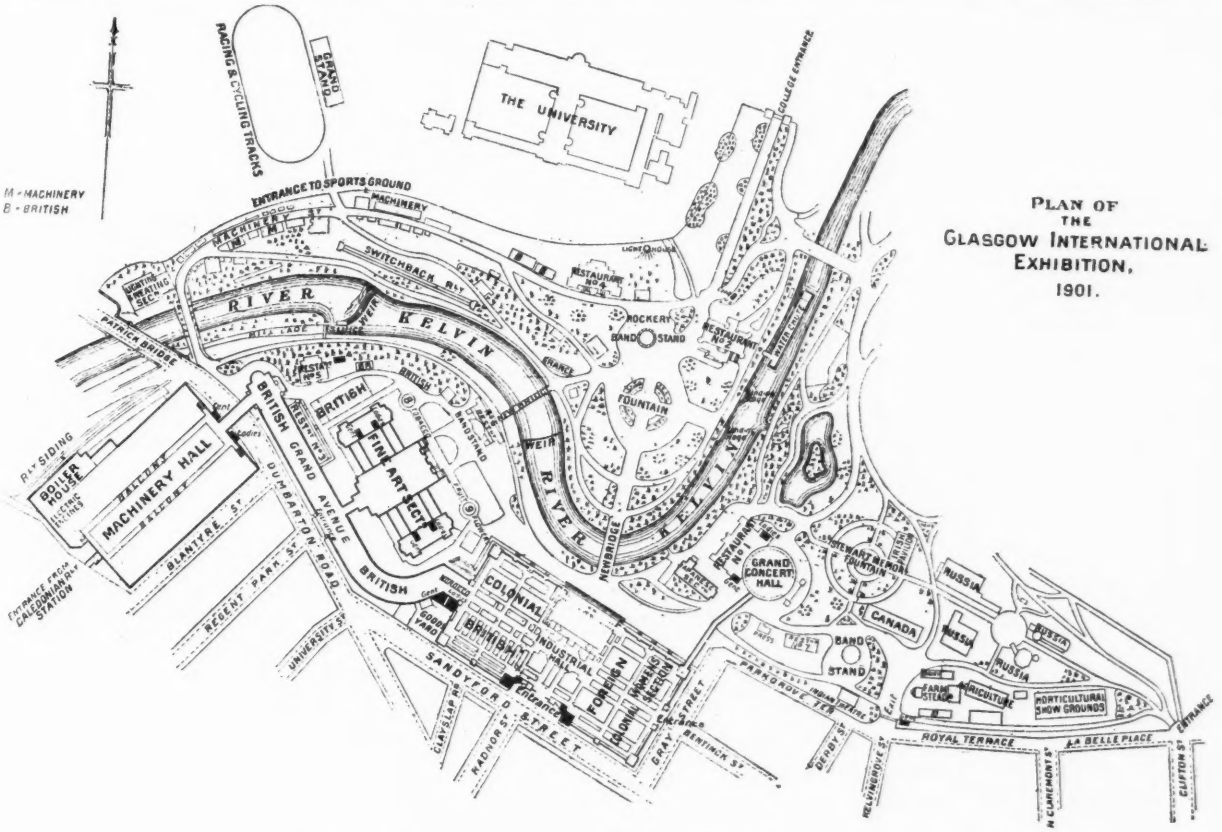
A. W.

London, April 24.

Industrial Development of California.

Dr. F. A. C. Perrine, late professor of electrical engineering at Leland Stanford University, recently addressed an assembly of engineering students at the University of Illinois on the "Industrial Development of California." He explained the present economic, social and industrial progress of California, arising from the electrical development and utilization of the water powers abounding in the mountain ranges of the state. Since coal from Australia, China and other Pacific fields costs $12 per ton delivered at the seaboard in ballast, it has been heretofore impossible to develop mines, factories, electric lighting and electric railways and other industries dependent upon cheap power. By means of the transmission of electrical energy throughout the state, great advance has been made in cheap manufacturing. Dr. Perrine dwelt at length upon the unprecedented engineering difficulties encountered in the electrical development of Californian water powers. He mentioned many examples of practical work that would have been considered impossible by eastern engineers, citing an instance of the storage of water to last over the dry season of about 150 days.

It has been announced by the Twin City Telephone Company, of Minneapolis and St. Paul, Minn., that it will spend $500,000 in the near future on improvements.



PLAN OF THE GLASGOW (SCOTLAND) INTERNATIONAL EXHIBITION. [Copyrigh , 1901, by *Engineering* (London).

Vacuum Tube Lighting by Metallic Vapor.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your journal for April 27, 1901, you wrote on what you called the Peter Cooper Hewitt lamp, saying that Mr. Hewitt hit upon the simple expedient of using a metallic vapor enclosed in a glass tube and that the discovery was of deep interest. I here state that the discovery was not made by Mr. Hewitt. I have used such tubes since the Summer of 1896. In "Notes on Light," which have been appearing in your journal for four years, vacuum tubes with mercury cathodes have been figured. Refer to note lxxxv, "Mercury Cathodes," in the ELECTRICAL REVIEW for January 17, 1900. There you will find the tube, which you now call new, described and illustrated, the statement being made that it gave a bright light. Also in the *American Journal of Science*, for November, 1900, the tube is mentioned in an article on the cathode stream, and it was said that the light it yielded was brilliant. These observations were also copied into the foreign journals. Industrial applications of scientific observations are easy to make but not interesting unless they can be used for the relief of human suffering, and under no circumstances do they rise to the region of discovery.

WILLIAM ROLLINS.

Boston, April 28.

Electric Lighting

Fire totally destroyed the power-house of the Egg Harbor, N. J., city electric lighting plant recently with its entire equipment. The loss was about $10,000.

Citizens of Shreve, Ohio, recently organized an electric light company to be capitalized at $5,000. The greater part of the stock is said to have been subscribed.

The Prismatic Electric Sign Company, of Syracuse, N. Y., has recently been incorporated, with a capital stock of $4,000, by F. C. Sherman, Harry Hill and Emma O. Sherman.

A contract has been closed between the city council of Hogansville, Ga., and a private corporation for electric lighting for that city, the plant to be erected by the company. Information regarding the installation may be obtained from the Mayor.

The Portland, Me., Lighting and Power Company is the name of a new corporation which has recently been formed in Portland to absorb and carry on the electric lighting and water-power development industries of the Cumberland Illuminating Company, Deering Electric Light Company and the Sebago Power Company. Mr. J. R. Libbey is president and Mr. E. H. Mather treasurer of the new corporation.

Mr. J. C. Ernst is said to be back of the big water and light deal which has been recently consummated at Newport, Ky., and which gives a foreign corporation the right exclusively to supply water and light to all of Campbell County outside of the corporate limits of Newport. The syndicate of which Mr. Ernst is the head will take over the Kentucky Highlands water and light contracts and the property controlled by the Bellevue Water and Light Company.

The great power installation at Trenton Falls, N. Y., on the West Canada Creek, 14 miles north of Utica, which has been in progress of construction for two years, has been successfully accomplished and power was turned on, lighting the city of Utica and operating the street-car lines and many industries on April 19. The installation consists of six turbines, four of 1,100 horse-power each and two of 100 horse-power each. The capacity of each of the generators is 1,000 kilowatts.

It has been decided by the directors of the Denison, Tex., Light and Power Company to make extensive changes in their plant, which when completed will give Denison a light and power circuit all the year around, 24 hours a day. The insurance companies are said to have condemned the present power circuit as being dangerous and the company will install new mains and employ different methods of transmission. The cost of the changes will be about $8,000, and the company expects that the plant will be entirely re-equipped by the middle of May.

Mr. C. S. Knight, of Ft. Wayne, Ind., is said to be planning for the erection of a power plant to furnish electricity for lighting, traction and other purposes in Greensburg, Pa., at a cost of $500,000. The intention of the company which Mr. Knight represents is to operate in all the towns in the vicinity of Greensburg, as the plant will be built with a capacity to supply all such villages within a radius of 40 miles with electric light and all of the various manufacturing plants in the district with power, besides lighting for commercial purposes and electric haulage in mines.

An electrical engineer is to be employed by the city council of Columbus, Ohio, to furnish plans and estimates for the municipal electric lighting plant provided for in the ordinance introduced into that body by Dr. Washington Gladden, and calling for an issuance of $132,000 in bonds. It was stated at the meeting of the common council that such a plant as the city required could be built at an expense of about $120,000, and that the work could be completed about the last of September, at which time the present street lighting contract expires. The matter was finally settled for the time being by deciding to appoint an engineer to figure on the proposition.

Emerson McMillin & Company, of New York, are engaged upon a consolidation of the electric lighting and power companies in Montgomery, Ala., and are interested actively in a large and important project for generating current by making use of the water power of the Tallassee Falls, which are situated near Montgomery. The corporation which will carry the project through is known as the Montgomery Water Power and Electric Company, the McMillin interests acting as its financial backers. Henry C. Jones, a Montgomery engineer, is credited with having interested capital in the plan, and made the negotiations necessary. Though the company, which will probably in the course of a few months absorb all the other local companies of a similar nature, has met strong opposition, it is now believed that matters are satisfactorily adjusted and that the plan will go through.

A franchise was recently granted by the common council of Davenport, Wash., to the Big Bend Light and Power Company for the transmission of power from the company's plant on Spokane River to the Big Bend flour mill, on the South Side. The company also asked the privilege of lighting the town should it find such an enterprise possible after installing the plant. Ten months' time was asked in which to do the work, after which time the company must release the contract should it fail to put in lights. It expects to spend $200,000 in Lincoln County and Mr. W. T. Stoel, who is representing it, stated that his company desired the option of lighting the city in order to have a basis on which to figure.

The recently incorporated American Light and Traction Company is to be a consolidation of the Western Gas, Grand Rapids Gas Light, Madison Gas and Electric and the St. Joseph Gas companies, and may include, among others, the Denver Gas and Electric Company, the Columbus Edison Company, the Montgomery, Ala., Light and Power Company and the Southern (San Antonio) Light and Traction Company. The total capitalization of all the companies, exclusive of bond issues, is about $35,000,000 and the American Light and Traction Company will have, when its plans are completed, $50,000,000 capital, although at the present time its capitalization is the nominal sum of $2,000, with the privilege of increase as may be necessary. The company has the right, under its charter, to incorporate with itself electric lighting, power and traction plants and is financed by Emerson McMillin & Company, of New York city. Among the directors of the company are Emerson McMillin, Anton G. Hodenpyl, Philip Lehman, W. W. Foster and others.

A Handsome Souvenir.

The Albany & Hudson Railway and Power Company has issued a few copies of an *edition de luxe* of photographic views of its fine equipment, a copy of which has been received by the ELECTRICAL REVIEW. The lines of this company extend from the city of Albany to Hudson, N. Y., and comprise the longest heavy railway operated by electricity in the world. The souvenir volume is a superb specimen of illustration.

Electric Railways

Fire destroyed the car barns and 35 cars of the Birmingham, Ala., Railway, Light and Power Company, on April 17, the loss amounting to about $75,000.

The stockholders of the Shamokin, Pa., & Mt. Carmel Electric Railway Company are to increase their capital stock from $500,000 to $750,000 to build an extension to Sunbury.

The Chattanooga, Tenn., Rapid Transit Company is to absorb the Chattanooga City Electric Railway Company and other local lines. One system will be formed with a capital of more than $1,000,000.

It has been announced that the New York & New Haven Railroad Company will soon equip the Waterbury, Ct., division of its system with electricity. The expense for machinery alone will be $300,000.

A Baltimore syndicate has recently purchased the San Francisco, Cal., & San Mateo Electric Railway Company for $1,600,000. Interested in the purchase are J. B. Ramsey, James A. Gray, Jenkins Brothers, H. A. Parr and others.

A new electric railway is soon to be built between Rockville and Stafford Springs, Ct. The company will have a capital stock of $50,000, with privilege of increasing it to $700,000. Among those interested are E. C. Dennis, George Sykes and F. E. Helay.

A mortgage for $350,000 has recently been filed by the newly incorporated Fox River Valley Gas and Electric Company, of Appleton, Wis., to secure an issue of bonds to be made by the company for the purpose of improving the Appleton gas plant and Neemah-Menasha gas and electric light plant. The mortgage bears five per cent interest, in gold.

The city of Manchester, N. H., is to have a new and complete electric light plant some time during this coming Summer, and Mr. John Marsden, of Utica, N. Y., is said to be interested in it. The minimum capacity of the plant will be about 1,800 incandescent lights in addition to several arc lamps and the entire plant is expected to be in working order by about the first of June.

The Missouri River Power Company, which owns a dam and power plant at Cañon Ferry, Mont., is soon to build another dam across the Missouri River at Stubbs's Ferry, five miles below the plant now in operation. The new station and dam will cost about $1,000,000, developing 10,000 horse-power, which, with part of the power now generated at Cañon Ferry, will be sent to Butte.

The syndicate which owns the Cincinnati, Ohio, Traction Company and leases the Cincinnati Street Railway Company, has recently organized the Union Traction Company, of Cincinnati, with a capital stock of $15,000,000. The incorporators are William L. Elkins, P. A. B. Widener, Thomas Dolan and Randall Morgan. The stock is divided half and half between preferred and common.

Plans are ready for a new electric traction road from Pittsburgh to Charleroi, Pa., and the banking house of Mellon Brothers is to finance the proposition. It is the purpose of the Mellons to provide a high-speed express service for towns along the upper Monongahela River, besides local traction systems in various towns to be touched by the long-distance road. The new express line will reach a population in the valley of about 40,000 to 50,000.

Mr. Thomas N. Fordyce, general manager of the Miami, Ohio, & Erie Canal Transportation Company, recently said that the construction work on his line was being pushed as rapidly as possible, and stated that he believed the line would be in working order between Cincinnati and Dayton, a distance of 68 miles, by January 1. A line will be built along the tow path of the Erie Canal and the boats are restricted to a maximum speed of four miles an hour so as not to do any damage to the canal banks by washouts. The contract of the company with the state limits the company to the transportation of freight, so that it can not compete with passenger lines.

Recently published statistics regarding the increase and development of street railways in Massachusetts during the past ten years show that in 1890 there were 78 companies, which in 1900 had increased to 118. The comparatively small increase in the number of operating organizations is because, in many instances, the companies have been consolidated. In 1890 the total mileage was 612, while in 1900 it was 2,037, of which 1,908 miles are operated by electricity. The gross liabilities of the companies in 1890 were $25,611,989, while in 1900 they were $95,062,946. The total capital stock in 1890 was $14,879,130; in 1900 it was $48,791,168. In 1890 the total number of passengers carried was 167,073,846, and in 1900, 395,027,198.

Views, News and Interviews

If Professor Pupin's invention is carried into effect by the telephone companies that have a right to use it it will greatly extend the area of underground wires. It was possible before this invention to place wires underground where there were 50 in active use—it could not be done with economy for a less number—and then only within a limited area; now with the possibilities of the Pupin invention it is likely that long-distance wires will soon disappear from the poles (and with them the poles), and will be laid beneath the surface of the earth where hail-storms and wind-storms can not affect them, safe from all danger, with the possible exception of earthquakes and the well-digger. The sheet of copper wires, glistening in the sun, which is to be seen spanning the country between New York and Chicago and other big cities East and West, will then disappear, and the countryman can no longer "hear the messages" passing over these metallic strands.

New York city will pay $5.22 each minute for its street lighting this year, which means 78 cents for each inhabitant, or $2,745,000 in all. A big bill, the largest of its sort in the country, but not the largest in proportion to population, says the New York *Herald.*

Of the great cities of the country, Baltimore comes next above Chicago, and pays 68 cents for each of its 509,000 inhabitants, or $350,000 in all. Then comes San Francisco's 343,000 population, paying $245,000, or 71 cents for each one. Next above that is New Orleans, where each of the 287,000 inhabitants pays 80 cents, or $230,000 in all.

Washington follows with 83 cents for each of its 279,000 residents, which equals $233,000. Each Clevelander pays two cents more than each Washingtonian, or $325,000 for the 382,000 inhabitants. We then jump to $1.10 for each of the 561,000 Bostonians, or $650,000 in all. Another jump makes the 324,000 persons in Cincinnati pay $425,000, or $1.30 for each one.

At a recent wedding in Union, N. Y., a lady from Illinois and a gentleman from Kentucky were married by phonograph, because the bride had diphtheria. The house was quarantined, no one being admitted, and the bridegroom conceived the brilliant idea, procuring a clergyman and two phonographs. In one of these the minister's questions and the gentleman's answers were recorded. The cylinders were then transferred, and the two machines sent to the bride. When they were set in motion, she answered the questions propounded by one machine, speaking into the mouth-piece of the other.

Export Notes

The monthly statement of the exports of the domestic products of the United States as given out from the Bureau in Washington shows that for the last eight months the total reached was $598,470,375, or an increase of $80,000,000.

An electric traction system is soon to be constructed in the Barbadoes Islands and New York capitalists are reported to be conferring with Canadian interests for the purpose of jointly building and operating the road, which will cost nearly $500,000. If the plan is successful the road will be the first electric system in that part of the world.

An American syndicate is said to have approached the Empresa Street Car Company, which operates the mule-car lines in Monterey, Mexico, with a view to purchasing its system. If the deal is pushed through, the existing lines will be operated by electric power and a considerable extension in tracks will be laid within the limits of the city.

So far as can be ascertained among the various export houses of New York, there is very little doing in the export trade with Japan, and it seems to be the opinion among such firms that trade will not assume its former proportions until Japan secures some outside financial assistance in order to develop the natural resources of the country.

A gentleman who has recently returned to New York from Cuba takes a decidedly gloomy view of the prospects of future machinery orders for Cuban and other West Indian sugar plantations, stating that outside the large contracts which are being placed by American companies formed to develop the cane lands in Cuba, there are but few orders in sight.

Cities in Australia are rapidly becoming among the best markets in the world for the shipment of American rails, and as an instance of this is cited a contract which was recently closed for 10,000 tons of steel rails which are to be shipped to Sydney for the New South Wales Government railways. Another American company has secured a similar order for 3,000 tons for the same system.

Calcutta, India, is the most advanced of the Asiatic cities in electrical matters, and its popularity there has, in a very short time, assumed vast proportions. **All public and private buildings of any pretension** are said to have their electric **installations for lighting and pulling punkahs, while there is a proposition now on** foot to introduce electric lighting and railway systems in Rangoon, Burmah.

Large quantities of railroad supplies were recently taken to Cape Town, South Africa, among which were $60,000 worth of street car material, $15,000 worth of electrical supplies and $10,000 worth of steel rails. While the orders from South Africa for manufactured material are said to be comparatively small in any one line, the merchants interested in the trade claim that in the aggregate they make a good showing.

It is reported that the Siamese Government is about to let contracts for the construction of 125 miles of railroad, which will have an equipment of 19 locomotives, 38 passenger coaches and 211 freight cars. The line is open from Bangkok, the capital of the kingdom, to Korat. This section of the road is 28 miles in length. Another portion of the line will be finished very soon between Lopburn, Nakon and Sawan, a distance of about 80 miles.

A Danish corporation, known as the Siam Electric Company, was recently formed in Copenhagen, Denmark, for the purpose of operating an electric light plant and electric traction system in Bangkok, Siam. The company is now placing contracts in the United States, as the lighting plant which was originally contracted for with a German manufacturer is reported to be working unsatisfactorily. The whole plant will therefore be replaced with American machinery and the General Electric Company is reported to have secured a contract for part of the equipment. The electric line will be 10 miles in length, and will probably be operated on the overhead trolley system.

Twenty thousand tons of bridge steel for the Guayaquil & Quito Railroad Company, in Ecuador, South America, and a large number of steel buildings for a Mexican mining company, with several big contracts for manufacturing buildings to go to Australia and a large railroad bridge for the Sandwich Islands have been received recently by the American Bridge Company. It is also stated that this company's tender for a large foreign contract exceeding in size everything that has heretofore been attempted has been accepted, and that one of the company's engineers recently sailed from New York to complete the arrangements. The officials of the company decline to say anything about the matter until all the details of the contract are successfully consummated, but admit the facts substantially as stated, considering that the matter in question is the most important foreign contract the company has as yet taken.

Telephone and Telegraph

One of the attractions of the coming exhibition at Glasgow, Scotland, will be a complete reproduction of a telephone exchange in full working order.

The Howard Telephone and Electric Lighting Company, of Ellicott City, Md., was recently incorporated for $25,000 by R. A. Martin, E. Walton, W. W. Burton and others.

A franchise was recently granted to the Masillon, Ohio, Telephone Company to operate an exchange in that city. The company has 35 subscribers to start with and has a number of others promised.

Construction work has been begun on the new telephone line between Richmond, Va., and Petersburg, at a point about midway between the two cities. The work of connecting Richmond with Newport News was begun some time ago at Lee Hall.

An increase of 6,106 instruments in the net output of the American Telephone and Telegraph Company for the month ended April 20, as compared with the same month last year, makes a net increase of 12,829 instruments since December 21 last.

James H. McGill, of Valparaiso, Ind., is interested in a telephone line between La Crosse and Valparaiso, with connections to La Porte. Work has not as yet been begun, but it is expected that construction will be commenced as soon as the weather permits.

A new telephone enterprise has recently been formulated in Parkersburg, Iowa, and is comprised of local capitalists and the old Cedar Valley Telephone Company. A new switchboard will be put into the local exchange and additional poles and wires set up.

At the annual stockholders' meeting of the Gainsborough, Tenn., Telephone Company G. W. Stevens was elected president, James N. Cox general manager and J. T. Anderson secretary and treasurer. The company plans extensive improvements to its various lines in the near future.

Reports from Rochester, Ind., indicate that the Rochester Telephone Company has purchased the telegraph line along the Cudahy oil pipe line from Roann to St. Pierre, a distance of 71 miles, and will rebuild the system, opening seven ex-

changes. Connection will also be established with the various local telephone systems situated at towns in the vicinity.

The greater portion of the modern improvements inaugurated by the Southern Bell Telephone Company at Jacksonville, Fla., have been completed. The exchange building has been completed, and in a few weeks the plant will be in operation. Mr. G. H. Cole, of the Bell Telephone Company, has charge of the work.

The Mexican Telephone Company recently filed the following statement under date of April 1, 1901:

Assets:	
Cash	$27,735
Franchises and plants	1,547 653
Miscellaneous	11.352
Balance profit and loss	240.960
Total	1,827,702
Liabilities:	
Capital stock	$1,808,710
Debts	18.992
Total	1,827,702

Negotiations are being carried on between Philadelphia capitalists operating telephone lines in Pennsylvania for the purchase of the Paterson, Passaic & Suburban Telephone Company of New Jersey. The parties interested are desirous of getting into New York, and it is with a view to effecting this that they desire to control the lines of the Paterson company.

The Everett syndicate, which controls the Federal Telephone Company, of Cleveland, Ohio, is reported to be making an effort at obtaining a franchise for an independent telephone company in Kansas City, Mo., the negotiations being conducted through Judge J. M. Thomas, of Cleveland, who is the president of the Independent Telephone Association of the United States.

The Indian Telephone Company, of Vinita, Indian Territory, is soon to increase its capital stock to $35,000, and will become incorporated under territorial law. The company is stated to be extending its lines and increasing its business rapidly, and the necessity of the telephone to business men in Vinita is reported as having been recognized and the advantages of the instrument appreciated.

Reports from San Antonio, Tex., state that the San Antonio Telephone Company has in active operation about 1,500 instruments, and while the company has had to contend with serious difficulty in getting its material, which has ever since the company was organized failed to arrive on time, it has done the very best possible work under the circumstances and been indefatigable in its efforts to live up to its promises.

The Southern New England Telephone Company has recently absorbed the Ansonia, Ct., Telephone Company, the details having been completed a few days ago. President M. F. Tyler, of the Southern company, stated that the absorption was in the nature of a friendly sale, and added that his company would carry out all the contracts of the Ansonia corporation so far as might be possible, and would continue the business as previously.

At the annual meeting of the Standard Telephone Company, of Atlanta, Ga., recently held in that city, important improvements, with enlargements and extensions, were planned for the system. The stock of the company is held mainly in Philadelphia, Pa., and it is intended by the stockholders to extend the present lines so as to meet the demands of the people in suburban districts who desire to secure connection with the city of Atlanta.

It has been decided by the Lehigh Telephone Company, of Allentown, Pa., to construct two lines running into Berks County, one by way of Emaus and Macungie and thence to Reading; the other to run from Slatington to Hamburg. Thirty subscribers have been secured for the first line and 42 for the second. The Lehigh company will be remembered as the new independent corporation which owns half of the stock of the Schuylkill Valley Traction Company. The former has nearly 1,200 subscribers in Lehigh.

When the post office engineers of London, England, recently visited the United States and inspected the most modern telephone installations it was not expected that their work would have such speedy and far-reaching results as it has. Complaints have now been received in London that £1,000,000 of the £2,000,000 voted for the establishment of post office telephones has come to the manufacturers of this country, and it is expected that the leading municipalities throughout Great Britain will follow the example set by the government's engineers.

A special meeting of the directors of the Chicago and the Central Union Telephone companies was held on Wednesday, May 1, in Chicago, Ill., at which time Mr. John I. Sabin was elected president of both companies, and Mr. John M. Clark, president of the Chicago Telephone Company, was appointed chairman of the board of directors of that company. The Central Union is reported to be earning five per cent dividends, but has not paid any for some time past. It is now believed, however, that dividends will be resumed. The company's capital is $6,500,000, its bonds $6,000,000, and its floating debt $1,250,000. The reorganization and consolidation plans provide for about $10,000,000 in working capital.

Automobiles

Automobiles are soon to be used in the postal service of Munich, Germany, and it is said that the vehicles employed will be electric tricycles.

It is said that the first automobile in the Philippine Islands is an electric vehicle which was imported for the use of the United States Army Signal Corps.

The city authorities of Hanover, Germany, have recently appropriated 80,000 marks ($19,040) for three automobiles for the use of the city's fire department, provided that they prove satisfactory during a certain trial period.

Automobile ordinances in Cincinnati, Ohio, fix the speed limit for the city at eight miles an hour. Lamps and bells are required and no two machines may be run abreast without special permission from the proper authorities.

A recent incorporation is that of the Standard Automobile Company of New York City, which has been chartered for $125,000 by G. Levy, R. G. Rudd, Jr., and others. Its principal office is 20 Clark avenue, Jersey City, N. J.

The officers of the Worcester, Mass., Automobile Club for the year 1901 are: President, J. W. Bigelow; vice-president, Edwin Brown; treasurer, B. A. Robinson; secretary, H. E. Sheland; chief marshal, W. J. H. Nourse; consulting engineer, M. A. Macker.

When the New England Electrical Vehicle and Transportation Company goes out of existence, the failure will be most felt by the New York stockholders, who hold two-thirds of the 223,498 shares of stock outstanding. A majority of the stockholders has agreed to liquidate. The stock was recently selling in New York at 2¼@½, though the cash on hand and real property at cost price to the company figure out a liquidating value of 3.54 per share, and it is believed that the company will pay nearly $5 a share at the final closing up of its affairs, which was the amount originally paid in. Real estate in Boston and Newport cost $184,853, and $165,374 has been spent in improvements, so that the market value of the property has been greatly enhanced. Altogether $925,684 has been expended for vehicles and machinery, but what this property will bring is unknown. There are outstanding at the present time 1,674 subscription certificates, representing 26,512 shares of stock.

PERSONAL.

Mr. George G. Blakeslee has been appointed general manager of the Albany & Hudson Railway and Power Company, *vice* Maurice Hoopes, resigned. Though Mr. Blakeslee has been identified heretofore mainly with electric lighting companies, he is considered a very able electric railway man, and has had considerable experience in a general way through his connection with the Waterbury Traction Company, both before and after its absorption by the Connecticut Lighting and Power Company. For the last seven years Mr. Blakeslee has been identified with companies controlled by Mr. A. M. Young, especially the East Chester Electric Company, Larchmont Electric Company, Port Chester Electric Light Company, and the Pelham Electric Light and Power Company, all of New York.

Mr. Edward Hansom, president of the Havana Electric Railroad Company, recently returned to Montreal from Cuba and states that satisfactory progress has been made in building the electric road at Havana, about half the line being in operation at the present time. Mr. Hansom says than in Havana no one walks who can afford to ride, adding that there are 1,400 licensed cabs and 200 omnibuses employed there.

The marriage of Dr. Cary Talbot Hutchinson and Miss Susan Dimock was solemnized at the home of the bride's parents, Mr. and Mrs. H. T. Dimock, New York city, on April 30, the Rev. A. H. Judge, of St. Matthew's church, officiating. Dr. Hutchinson is a well-known electrical engineer in New York and was recently appointed one of the engineers of the Rapid Transit Subway Commission.

Mr. Thomas A. Edison recently entertained Signor Marconi and a party of New Yorkers at his factory in Orange, N. J. The party included, among others, John Bottomley, a nephew of Lord Kelvin; H. A. Hemphill, of the Norfolk & Western Railroad; David Young, second vice-president of the North Jersey Street Railway, and Frank Brewer, of the Orange Mountain Traction Company.

Mr. George R. Scrugham is the new president and general manager of the Cincinnati, Ohio, & Eastern Electric Railway Company, which is about to build an electric railway eastward from Cincinnati. Mr. Scrugham was for 10 years connected with the Creaghead Engineering Company, of Cincinnati, as its general superintendent, and has had a varied experience in the electrical field.

Mr. R. E. Danforth, who was for several years superintendent of the street railway system of Buffalo, N. Y., has accepted the position of general manager of the Lake Shore Electric Railway Company, of Lorain, Ohio, which is a consolidation of the Lorain & Cleveland Railway, Sandusky & Interurban Railway, and the Sandusky, Norwalk & Southern Railway companies.

Mr. S. R. Smith has resigned from the superintendency of the Black River Traction Company, of Watertown, N. Y., to become general manager of the Cincinnati, Columbus & Southern Railway Company, of Columbus, Ohio. His successor will be Mr. Henry Le Febre, who was formerly manager of the Harmon Machine Company.

Mrs. P. D. Armour, of Chicago, Ill., has announced a further gift to the Armour Institute of a building which will cost $500,000. This last benefaction is separate from the gift of $1,000,000 made the day before by Mrs. Armour and her son, Mr. J. Ogden Armour.

Mr. Charles Currey, recently general superintendent of the Cleveland, Ohio, Electric Railway Company, has been appointed general manager of the Toledo & Monroe Railway Company, which is constructing a road from Toledo to Detroit, Mich.

Sir William C. MacDonald has added $150,000 to his former benefactions to McGill University, in Montreal, Canada, to establish on a firm financial basis the chemistry, physics and mining departments, and to endow a chair of botany.

Mr. Louis H. Mountney, of Philadelphia, Pa., late superintendent of the Springfield, Ohio, Traction Company, has been appointed superintendent of the Lima Electric Railway and Light Company, *vice* J. E. Townsend, resigned.

Signor Guglielmo Marconi recently left for Europe on the Campania, and before leaving stated that he is associated in no way whatever with any American company having for its object the development of wireless telegraphy in this country.

Mr. James F. Heyward, late general manager of the City and Suburban Railway Company, of Baltimore, Md., has established himself as a railway engineer with offices in the Washington Building, New York city.

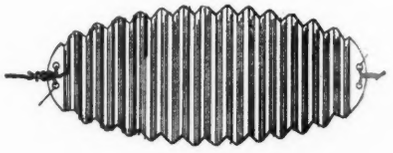
Mr. J. B. Houseman, of St. Louis, Mo., has recently been appointed general manager of the Garrett, Albany & Northern Indiana Electric Railway Company, of Auburn, Ind.

Mr. William R. Abery, auditor of the Cincinnati, Ohio, Traction Company, recently resigned his position after a service of nine years and has retired from active business.

Recent Electrical Patents

Another patent has been taken out by Mr. William F. Bossert, of Utica, N. Y., on electric switches, the aim being, as in his other inventions described in the ELECTRICAL REVIEW, to improve their construction. In the present instance, the clips which receive the knife blades are formed of a single piece of metal, preferably a single strip doubled together, the terminals being spaced a sufficient distance apart to receive the blade and having their lower portions bent at right angles to form an arm that is secured to the insulating base. A set screw passes through the base and extends to a suitable height between the clips to form a stop that limits the inward movement of the blade. The inventor has also improved the connection between the handle crossbar and the blades by constructing the ends of the blades with an undercut notch which receives the head of a fastening bolt that passes through the bar.

Mr. George Westinghouse has obtained control of another patent on an improvement in glower lamps, the present invention, patented by Mr. F. M. Goddard, relating more particularly to a novel con-



GLOWER LAMP HEATER.

struction of heater for the glower. It consists substantially of a thin plate or disk made of insulating material and having grooves cut transversely across one face. The edge of said disk is provided with projections and the conducting wires are secured to the opposite ends of the disk. The heating conductor is fastened at one end to one conductor wire, and is wound through successive grooves in the face of the plate by looping it around the projections at the end of the same, the opposite end being likewise secured to the other terminal wire. The grooved surface is then covered with a paste of material similar to that of the disk, and the whole is heated until said paste is hardened.

The engagement of Signor Guglielmo Marconi, the wireless telegraphy inventor, to Miss Josephine Bowen Holman, daughter of the late Justice J. A. Holman, of the Supreme Court of Indiana, is announced. The marriage will take place next Fall in either New York or Indianapolis.

MODERN TELEPHONE ENGINEERING—II.

BY KEMPSTER B. MILLER.

There has recently developed, however, a strong tendency on the part of the Bell and the independent companies to build central offices with a much larger equipment than 6,000. The Cuyahoga Telephone Company, of Cleveland, is now equipped with a multiple board having a capacity of nine thousand six hundred (9,600) lines installed, and with an ultimate capacity of about twenty thousand (20,000). The board at Paris, France, equipped by the Western Electric Company, has a present capacity of something like nine thousand three hundred (9,300) lines, and the Kinloch Telephone Company, of St. Louis, Mo., has a present equipment of eight thousand eight hundred (8,800) lines. I am informed that a number of exchanges operated by the Bell company are now being planned or built, having a capacity of nine thousand (9,000) lines and upward.

I believe fully that the future systems in large cities will be operated with fewer and fewer central offices and consequently with larger switchboards. This belief is rendered tenable by the present tendency of operating companies and also recent improvements in switchboards by which the mechanical limitation of six thousand (6,000) lines is removed and by which as many as twenty-five thousand (25,000) lines can be handled in a single straight multiple switchboard and even as great a number as one hundred thousand (100,000) lines by the use of systems now shown to be practicable for a smaller number.

The fundamental object of the multiple switchboard is to place within reach of every operator a line terminal or spring jack, as it is called, for every subscriber's line entering the exchange. As is well known, the switchboard is divided into sections, each section being of such size as to allow an operator, without undue exertion, to reach over its entire surface. On each section are placed a certain number of line signals, by which the subscriber is enabled to attract the attention of the operator and a corresponding number of line jacks, by means of which the operator may make the initial connection with that line in response to such signals. These jacks, which are associated with the line signals, are termed answering jacks. In addition to the line signals and answering jacks are provided what are termed multiple jacks, there being one of these on each section for every line in the exchange. To express this in a different way; the various lines entering the central office are divided up into suitable groups, these groups terminating in line signals and answering jacks at the various sections of the multiple switchboard. In addition to this, all the lines entering an exchange are carried to every section of an exchange, each line terminating in every section in a multiple jack. An operator seated at any section, in response to a display of one of her line signals, inserts one plug of a pair into the corresponding jack, and having ascertained the number of the subscriber desired inserts a corresponding plug of the pair into the multiple jack of the subscriber called for. As every subscriber's line has a multiple jack at every section of the switchboard, any operator is able to complete by herself any connection called for at her board.

The size of the section is limited by the reach of the operator, and it is this fact that places a mechanical limit to the size of an ordinary multiple switchboard. It has been found impracticable in most cases to place the jacks closer than on half-inch centres, and under these conditions no more than six thousand (6,000) of the multiple jacks could be placed, in addition to the other apparatus, within the space afforded by one section.

Two distinct methods have been followed with the intent of removing this limit. Each has been productive of excellent results; each has been used separately, but up to the present time they have not both been incorporated into the same installation. The first of these methods is an obvious one and contemplates the reduction in the size of the spring jacks with a view to getting more of them within the reach of the operator. The mechanical difficulties in this line have been great, owing to the fact that the circuits of the switchboard were so complicated as to require three, four and sometimes even five contacts to each spring jack. The Western Electric Company, in the Paris board, succeeded in reducing the dimensions of the jack to three-eighths of an inch (⅜ inch) centres, both horizontally and vertically, and thus rendered practicable the installation of a switchboard having a capacity for considerably over nine thousand (9,000) lines. I believe that there are other boards which have been installed with success having this size of jack, and that others are at present in course of construction for large cities in this country. This jack had three contacts, and I believe is the smallest that has ever been put into extensive use.

Quite recently the company with which I am connected has perfected a system of circuits for a multiple switchboard so simplified that only two contact points are required for each jack; that is, merely a tip spring and sleeve, these two contacts always standing open and never engaging each other. By the use of this two-wire system, it is perfectly practicable to build the jacks on one-quarter-inch centres, horizontally and vertically, and thus place within the reach of a single operator no fewer than 25,000 lines.

The second method of increasing the possible size of multiple switchboards was devised by Mr. M. G. Kellogg, and is now working in two large exchanges in this country. In this system, which is known as the divided multiple system, the switchboard and lines are divided each into four divisions. The switchboard consists of four multiple boards, all in the same office, and to these is connected one of the groups of lines, in the same manner as if they were in separate exchanges. With this arrangement, if no further provisions were made, it would be possible for any subscriber in one division to obtain a connection with any other subscriber in his own division, but not with any one in any of the other three divisions. In order to enable any subscriber, in, say, the A division, to obtain a connection with a subscriber in the B, C or D division, means are provided, not for trunking between the divisions, but for enabling the calling subscriber to signal directly to one of the operators in the division in which the line of the called-for subscriber belongs. This necessitates the use of four line signals and four answering jacks for each line, one of each in each division, and of means whereby the subscriber may display any one of the signals to the exclusion of the others. Instead of trunking between exchanges, therefore, the subscriber sends his call directly into the division of switchboards to which the desired subscriber belongs.

By the use of this divided multiple switchboard it is seen that the ultimate capacity of any exchange is increased approximately fourfold; not quite this, however, because the extra line signals and answering jacks take up a portion of the room which would otherwise be available for the multiple jacks.

The significance of what I have said concerning the two methods of increasing the size of multiple switchboard will now be apparent. If the four division exchange were installed on one-quarter-inch centres, the capacity of such an exchange would be something over 90,000 lines operating without giving the operator as great a reach as they have at present in some multiple switchboards, and between the subscribers of this mammoth exchange there would be no trunking whatever.

National Electric Light Association's Convention.

As has been announced already, the twenty-fourth convention of the National Electric Light Association will be held at Niagara Falls, N. Y., on May 21, 22 and 23. The meetings will take place in the auditorium of the International Hotel, this hotel having been reserved for those attending the meetings. Rates have been made, upon the American plan, of $5 per day for rooms with bath attached, and $4 per day for rooms without bathroom. The various railway passenger associations covering the territory east of the Mississippi River have granted rates of one-and-one-third first-class single-trip fares for the round trip to Niagara, on the certificate plan. Arrangements have been made with the New York Central Railroad to attach extra cars to the trains leaving New York at 8.30 A. M. (Empire State Express) and 8 P. M. (Pan-American Express), Sunday and Monday, May 19 and 20, for the accommodation of visitors.

The programme, so far as it has been announced, is as follows:

PAPERS—"Arc Lighting at the Beginning of the Twentieth Century," by H. W. Hillman; "The Practical Side of the Incandescent Lamp," by F. W. Willcox; "The Foresee (4-C) System of Charging," by Louis R. Wallis; "A Station Load Diagram," by C. R. Van Trump; "Distribution of Current at High Potential in New York City," by Calvin W. Rice; "Storage Batteries in Central Stations," by Augustus Treadwell, Jr.

REPORTS will be presented by Committees on Grounded Circuits, Rules for Electrical Construction and Operation, Standard Candle-Power of Incandescent Lamps, Photometric Values of Arc Lamps, Analysis of Flue Gases, the Legislation Regarding Theft of Current, Amendments to By-Laws, Amendments to Freight Classification of Electrical Apparatus, Legislative Policy, Uniform Accounting. The topic, "Steam Heating from Central Stations," will be discussed.

All indications point to an unusually large attendance, both on account of the interesting programme presented and the selection of Niagara Falls, which is conveniently situated with reference to the Pan-American Exposition at Buffalo, as the place of the meeting.

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 227 bid and 228 asked, showing a gain of 1½ points. Metropolitan Street Railway, of New York, closed at 169¼ bid and 170 asked, showing a loss of 3⅝ points. Brooklyn Rapid Transit closed the week at 83⅜ bid and 83¾ asked, indicating a loss of 1⅞ points. Third Avenue Railroad, of New York, closed at 124 bid and 126 asked, showing a loss of 1 point. Manhattan Railway, of New York, closed at 126¼ bid and 126½ asked, indicating a loss of 2¼ points for the week.

On the Boston exchange, American Telephone and Telegraph closed the week at 175 bid and 177 asked, showing no change for the week. Erie Telephone closed at 59 bid and 60 asked, indicating a loss of 1 point.

Wall street, May 4.

Telephone and Railway Signaling.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Nearly every block station on the Erie Railroad Company's system is now equipped with its telephone, and the work of equipping all the stations is rapidly approaching completion.

It is found that the telephone is a most useful adjunct to the block-signal system. Attached to the wall of the block tower, with its two-way spring switch ready to throw it into the bell circuit on either side, it is to the signalman a quick and reliable means of verifying signals. It is at his service at any and every moment, and there is no need for his waiting under compulsion, as is generally the case on the telegraph wire, until the despatcher has given "O. K. and Complete" to a train order, or has raised some otherwise busy man up the road to get a train report. The value of the feeling of security with which it imbues the signalman is inestimable.

As special training is not necessary for its use it opens to the company a large field from which to recruit their force of signalmen, and also places in their hands one more line of occupation in which to use faithful but unfortunate employés who have become crippled in the train service, and thus incapacitated for service requiring heavy physical exertion. Such men, by reason of their active connection with the train service, bring to their new duties an experience which makes them doubly valuable. In many instances the telegraph becomes superfluous after the installation of the telephone, by reason of the location of the block station at a point where the ability to place train orders would be of no value. While we have not yet reached the point attained by a certain western road which has applied the telephone to the despatching of trains over a short but unusually busy section of track, still we feel that the possibilities are far from being realized.

Considering the trifling amount of training necessary to develop a first-class telephone operator as compared with the one or two years' practice which the Morse operator must undergo before being able to handle even the lightest work, it would seem that good policy demands that the railroad manager shall look with favor upon the telephone, and welcome it as a companion, if not a substitute, to the telegraph in the field of formal communication.

F. L. BLENDINGER,
Superintendent of Telegraph,
Erie Railroad Company.

April 20.

An Editorial Visit to the Pan-American Exposition.

About forty of the editors of the leading daily and weekly publications of New York city visited Buffalo on Saturday of last week and inspected the Pan-American Exposition. The party was under the personal guidance of Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad, and was taken to Buffalo in special cars attached to the Pan-American Express, a magnificent train, second only to the famous Empire State Express in its equipment and speed.

The most attractive feature of the visit to the exposition was the electrical illumination Saturday night, which impressed every one of the observing editors. It was a beautiful example of decorative electric lighting, and it was the opinion of all that this could not fail to prove of great interest to visitors from every country. Niagara Falls power station was visited and a ride taken over the Gorge Road, followed by luncheon at the Prospect House, Niagara Falls. The visit to the power-house was not without an awe-inspiring effect on the metropolitan scribes, who promptly realized that an immense industry had suddenly sprung into life here almost before they realized it and of great magnitude, while unique.

A very enjoyable dinner was tendered the editors at the Hotel Iroquois by the exposition company on Saturday evening, and Sunday evening the associated newspapers of Buffalo also tendered a dinner, President Milburn, of the exposition company, presiding over the first, and Mr. E. H. Butler, of the Buffalo *News,* presiding at the newspaper dinner.

It is probable that a more representative gathering of New York editors never visited, in a body, any interior city than the gentlemen who accompanied Mr. Daniels to Buffalo on this occasion. A few of those in attendance were W. Van Benthuysen, editor *World;* James C. Garrison, city editor *Press;* H. M. Stegman, city editor *Tribune;* T. E. Niles, managing editor *Mail and Express;* Hammond Lamont, managing editor *Evening Post;* Frank W. Mack, superintendent Associated Press; William Cullen Bryant, president New York Press Club and editor *Brooklyn Times;* John A. Sleicher, editor *Leslie's Weekly;* Gilbert Evans, managing editor *Brooklyn Eagle;* Oscar K. Davis, editorial department *Sun;* Henry Tyrrell, editor *Judge;* Richard Le Gallienne, London *Chronicle,* and Major J. B. Pond, the author of "Eccentricities of Genius." Mr. Daniels was accompanied by Mr. E. J. Richards, Mr. C. E. Lambert, Mr. C. R. Wager, Mr. J. E. Root, Mr. H. Parry and Mr. C. J. Laing, of railroad circles.

One pleasant feature of interest was the presentation of souvenirs of the occasion to the host, accompanied by entertaining but brief speeches. Mr. George Urban, of Buffalo, accompanied the party to Niagara Falls and explained the details of the great electric power-house to the visitors.

Steam Heating from Central Stations.

Of late years much interest has grown up in electric lighting and power circles regarding the opportunities of disposing of the only by-product of an electric station—hot exhaust steam—at a profit. Of the several systems that have been devised to accomplish steam heating over widely extended areas by means of pipe lines fed from a central station that of the American District Steam Company, Lockport, N. Y., here illustrated, has won much favor.

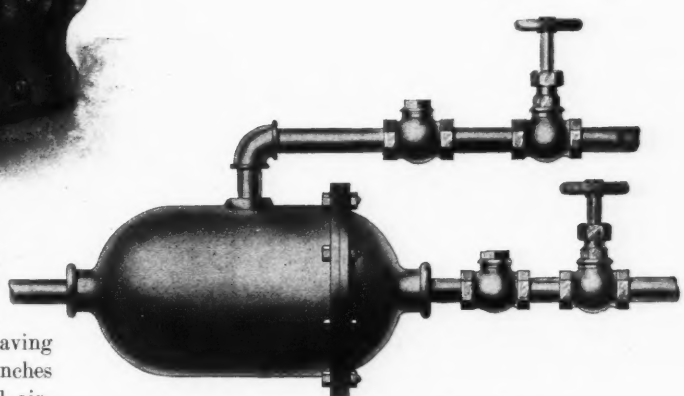
Economizing Coil for Steam Heat System.

The system of return mains formerly much in use has been discarded in favor of economizing coils, one of which is illustrated in the accompanying engraving, into which the water of condensation from the piping and heater system in the buildings connected is discharged. This coil, which has a continuous circulation, is placed in a tin-lined box having an outlet for hot air through a register in the floor above. While it does not increase the cost of piping in a building it adds no little to the direct effectiveness of the heating produced. Water leaving the coil can be used for any purpose for which hot water is desirable, or can be piped into the sewer. It is claimed that about 20 per cent less steam is required for the heating of a building piped with these coils than where more antiquated systems are employed.

In the installation of the system an automatic device, known as a variator with a flexible copper diaphragm, is installed at frequent intervals to take care of expansion and contraction in the line pipe. No packing is required; it is a fixed point from which services are taken and manholes are dispensed with. Its outer construction is well shown in the accompanying illustration.

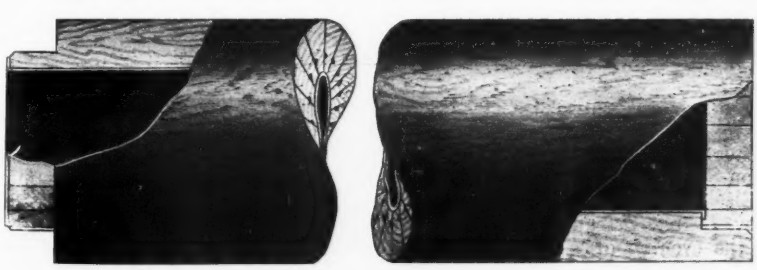
The standard system of insulation against loss of heat that has been adopted by the company is shown in the illustration herewith. The iron pipe used for conducting steam is covered with asbestos and is enclosed in a round tin-lined wooden casing, having a shell four inches thick and a dead air-space of about one and one-half inches between the tin and the asbestos covering of the pipe. This method has been adopted by the company after numerous experiments and practical tests on almost every variety of insulation known, and is considered by it the best. The pipe casing is made of selected timber, thoroughly dried and cut into staves with a tongue and groove running their full length. These are placed in a banding machine, where they are firmly bound together by stout galvanized steel wire spirally wound around the wooden casing at such a tension as to sink it well into the wood. The outside of the casing is covered with asphaltum, pitch and sawdust. After receiving its tin lining and having tenons and mortices cut on the ends it is ready for use. It is claimed that this method of insulation has reduced condensation and radiation losses at full delivery to from one-quarter of one per cent to six per cent per mile of pipe, varying according to the size of the mains.

The water heaters illustrated are designed for use in heating water for domestic purposes, hotels, etc., where large quantities of hot water are required. The general method of laying pipe line, with the variators and manhole curb at street intersections and the special anchorages adopted, also tile underdrainage, is simple and easily understood. It is stated that the durability of this system has been satisfactorily tested by 23 years' service at Lockport, N. Y., and by lesser periods in 150 other cities and villages.



Water Heater for Steam Heat System.

It is claimed by the manufacturers that in the case of electric stations the economy to be effected by selling exhaust steam for heating purposes is much greater than that attained by condensing. The question of added revenue to be derived from the sale of exhaust steam is one that appeals directly to every business manager or superintendent of an electric power station to-day.



Pipe Casing for Live Steam Pipes.

Variator for Steam Pipe Lines.

The Mercantile Electric Company.

Another evidence of the growth of St. Louis as a distributing centre for the large and rich country tributary to it, generally known as the South and Southwest, and also bearing testimony to the rapidly increasing trade in electrical supplies, is the recent incorporation of the Mercantile Electric Company, of that city.

It has been started upon a sound financial basis and its officers are men long identified with the electrical trade. It has accepted the exclusive agency for the Western Electric Company, of Chicago and New York, with which it is closely identified, for the entire southwestern territory.

The building occupied by it is in itself an index of the thorough preparation this new company has made to handle the business in this field. A short description of the group of buildings, one of which is here illustrated, will prove interesting, as there are probably no other buildings in the country having superior facilities for the rapid transfer and shipment of merchandise.

The buildings are grouped about the mouth of the tunnel and at the terminus of the elevated structure, through and over which all freight from the East must pass that enters the city. The tracks of the western and southern lines extend to the same point, which is known as Cupples Station. This station has become a feature of St. Louis, and well known throughout the transportation world. The occupants of the buildings comprising the Cupples group have direct access to the tracks of all the roads. Goods arriving in carload lots from any point in the United States are placed at the receiving door of the parties to whom they are consigned, dispensing with all hauling and requiring the goods to be handled but once. Shipping in carload lots is accomplished in like manner, cars being provided and placed at the disposal of the shippers on short notice. Small consignments and shipments are handled on a similar plan, except that instead of a freight car, a hand-truck, owned and controlled by the railroad company, is used. The goods are placed by the shippers, properly marked, upon these trucks which are handled entirely by the employés of the railroad company.

The aggregate daily tonnage at this station is over 2,000 tons, equal or exceeding that of almost any one of the freight depots of the country.

The workings of this system are always more or less interesting to the business public, and the Mercantile Electric Company extends to all an invitation to inspect its building, and to see the same in practical operation.

The officers of the company have provided ample quarters for the large stock they intend to carry, embracing everything used in the business of electrical construction, and, aided by their shipping facilities, are in position to give prompt service, and should soon establish for the company a reputation that will be a credit to the electrical trade.

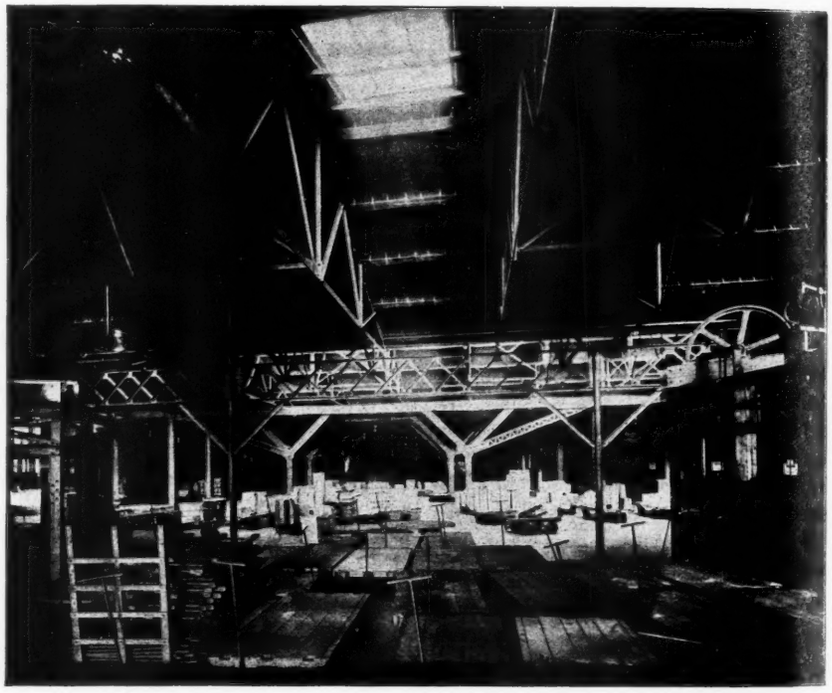
Boston Elevated Railway Opened.

The Roxbury division of the Boston, Mass., Elevated Railway was opened for service between the Pleasant street station of the subway and a point on Ruggles street on the afternoon of May 1. The time made was very slow in order to allow observances of the clearances on the way out. The run back was made in somewhat quicker time and it is believed that very fast time will be possible on that section of the line. The party which opened the system included Superintendent Neff, Division-Superintendent A. T. Tomlinson, Electrician Winsor, and Engineers Leadley, Cutter, Ostrup and others.

On the evening of April 30, the new elevated system over the subway incline near the north station was inaugurated with a train of three cars and though no trains are as yet running through at speed the opening was considered satisfactory by the officials of the road. At one portion of the system near the Haymarket Square station there was a break in the power rail so that it was impossible to work the cars past the point except by towing. Mr. Stuart Neff, the superintendent of the elevated railway, who has charge of the new electric equipment, is a graduate of the Rensselaer Polytechnic Institute and is considered a very able railroad man, having served a number of years in important and responsible positions with other railroad companies.

A New Interior Telephone.

In this progressive age, when every minute saved to the head of an establishment and to his employés is of vast importance in determining his dividends, and where labor and time-saving devices are eagerly sought after by all classes of business, it requires no very great effort to influence the business man to adopt the interior telephone as his means of communicating with the different departments or floors of his establishment. To be able to sit at one's desk and communicate instantaneously with any or all of the heads of departments or employés is a convenience that can hardly be estimated in dollars and cents.



TERMINAL SHIPPING FACILITIES OF THE MERCANTILE ELECTRIC COMPANY.

This condition can be reached only through complete intercommunicating service. The importance of these systems and the great amount of service they give justify the use of the very best class of apparatus. Telephone manufacturers have hitherto belittled the importance of this class of instruments and much cheaply constructed apparatus has been placed on the market. Cheap instruments are also apt to be followed by cheap wiring and unreliability to the great detriment of interior systems in general. Heads of large business houses, however, have found out that an interior telephone should be as constantly reliable and ready for service under all conditions as, for example, a speaking tube; but when in working order a telephone is far more efficient than a

speaking tube can possibly be, besides being available in many places where a speaking tube is not.

To meet this demand for a thoroughly reliable interior telephone service the Century Telephone Construction Company, of Cleveland, Ohio, has engaged in the manufacture of an instrument as carefully constructed as though intended for

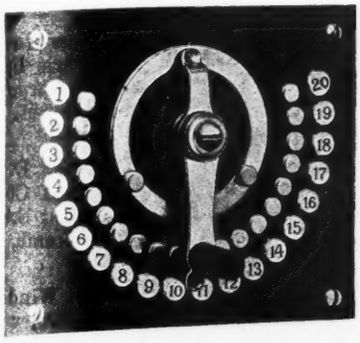


FIG. 1.—FULL METALLIC CIRCUIT CIRCULAR SWITCH.

the most exacting exchange service, combining its high-grade transmitter, double-pole receiver, and full metallic circuit switch.

But privacy is desired as well as reliability. To best insure this result full metallic circuits are as desirable as high-grade instruments. They cost but a trifle more than the common return plan of wiring, while, as a rule, they add 100 per cent to the efficiency of the plant. Fig. 1 illustrates a full metallic circular switch for this work. The lever arms are insulated from each other by hard rubber, and are entirely self-contained, while a strong rubbing pressure on the studs prevents the accumulation of dust and insures a reliable contact at all times. As each circuit is entirely disconnected from any others than the one in use on the same line with it, the system is entirely free from cross-talk where full metallic circuits are used, so that in a 10-point system it is possible for 10 telephones (five conversations) to be in use at the same time without the slightest interference.

One of the most attractive features about this switch is that it need not be complicated by the use of self-restoring devices which are almost certain to get out of order, and which are not necessary in intercommunicating work. In this system if the switch should not be returned to the home number after a conversation has been finished, no harm would be done as that station and no other than the one wanted can still be called from any other station, the wiring being so arranged that the bell is on its home number when the receiver is hung up; which is a very essential feature in a full metallic system.

In order to call a station it is only necessary to move the lever around to the point desired and push a button which rings the station wanted. When the conversation is finished the lever can then be left at that number and the station still be called, just as though it had been returned to the home number.

Fig. 2 illustrates a wall instrument arranged for a 10-point switch. This is the same switch already shown in Fig. 1, the call being made by a push-button in the bottom of the box as shown in the cut.

The woodwork of this box is either golden Flemish oak or walnut, and its design is very neat and compact as it only occupies a space of five by seven inches.

In Fig. 3 is shown a design of another wall instrument in which the talking battery is placed in the instrument itself with a common central battery for calling.

Fig. 4 shows a desk set with the switch mounted directly on the base. The handle is of polished hard rubber and all metal parts are heavily nickled.

As already stated, all of the above instruments are equipped with long-distance transmitters and double-pole receivers, and if necessary to switch the interior system to the regular exchange line they talk as well as the regular exchange instruments connected with it.

FIG. 2.—WALL SET WITH TEN-POINT SWITCH.

FIG. 3.—WALL SET WITH TALKING BATTERY.

FIG. 4.—DESK SET WITH SWITCH MOUNTED ON BASE.

Fig. 5 is a diagram of a metallic circuit system which only requires the use of one pair of wires for each telephone. These should be run in cables of No. 22 conductor B. & S. gauge. In addition there are two battery wires, used for ringing, which are common to all the instruments, but which are cut out of circuit when the hook comes up. These battery wires should not be smaller than No. 16 copper and should not, as a rule, be placed inside the cables.

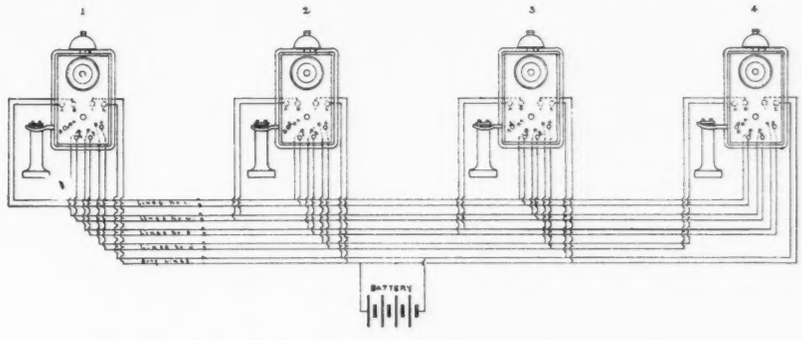


FIG. 5.—DIAGRAM OF METALLIC CIRCUIT INTERIOR TELEPHONE SYSTEM.

Aluminum was discovered by Wöhler in 1828.

Corporation News

COLUMBUS, OHIO — Pixley Electrical Company. $1,000.

SEBREE, KY.—Sebree Independent Telephone Company. $5,000.

GLEN WILLIAMS, CANADA—Georgetown Electric Light Company. $40,000.

AKRON, OHIO—Akron South Side Belt Line Railway Company. $10,000.

GREENSFORK, IND.—Greensfork Cooperative Telephone Company. $4,000.

PORT CLINTON, OHIO—Port Clinton Home Telephone Company. $40,000.

NEWARK, OHIO—Newark, Zanesville & Coshocton Traction Company. $10,000.

ASHLAND, OHIO—The Star Telephone Company has increased its capital stock from $50,000 to $100,000.

COOKEVILLE, S. C.—The Overton Telephone Company has increased its capital stock from $5,000 to $25,000.

LOUISVILLE, KY.—Louisville & West Point Electric Railway Company. $5,000. W. L. Weller, president.

BRIDGEPORT, OHIO—The Belmont Telephone Company has increased its capital stock from $15,000 to $75,000.

GOLDEN, ILL. — Houston Telephone Company. $2,500. Incorporators: T. J. Downing, L. W. Miller and others.

FORT WAYNE, IND.—Fort Wayne, Dayton & Cincinnati Traction Company. $1,000,000. Incorporators not named.

CARMEL, IND.—Carmel Mutual Telephone Company. $5,000. Directors: E. B. Murville, E. H. Collins and others.

FRASERVILLE, CANADA—Rimouski Electric Company. $100,000. Incorporators: Thomas Lebel, J. N. Poulinot and others.

VERSAILLES, IND. — Versailles Telephone Company. $5,000. Incorporators: A. Popper, J. W. Mills and Louis Straus.

CHICAGO, ILL. — Benjamin Electric Manufacturing Company. $2,400. Incorporators: W. C. Jones, C. B. Camp and others.

ELIZAVILLE, IND.—Elizaville Cooperative Telephone Company. $400. Directors: N. M. Hardin, A. W. Cash and others.

OTTAWA, CANADA — Glen Tay Power Company. $50,000. To produce and distribute electricity for light, heat and power.

DAYTON, OHIO—Dayton & Richmond Traction Company. $10,000. Directors: D. T. Baker, A. C. McDonald, C. J. Hall and others.

RIVERSIDE, CAL. — Riverside Power Company. $250,000. Directors: C. W. Rogers, J. H. Barbour, I. D. Rogers and others.

TRENTON, N. J.—East Jersey Light and Power Company. $250,000. Incorporators: A. M. Reed, George Holmes, B. F. De Frice.

PORTLAND, ME.—International Storage Battery Company. $1,000,000. President, Frank I. Moore; treasurer, J. E. F. Connelly.

LONDON, OHIO—Madison-Clark Telephone Company. $75,000. Incorporators: W. M. Jories, R. W. Boyd, A. S. Bell and others.

TOLEDO, OHIO—Toledo & Findlay Traction Company. $1,500,000. Incorporators: George B. Kerper, Henry Burkhold and others.

CHICAGO, ILL.—Independent Telephone Construction Company. $2,500. Incorporators: J. P. Harrold, W. Mannhardt, W. E. Caylor.

WILLOWBRANCH, IND.—Farmers' Telephone Company. $10,000. Incorporators: T. A. Seaman, J. W. Patterson, K. A. McCormick.

BOOTHBAY, ME. — Boothbay Harbor Light, Heat and Power Company. $10,000. President, K. H. Richards; treasurer, C. J. Marr.

PERTH AMBOY, N. J.—Seaboard Telephone Company. $10,000. Incorporators: C. K. Seaman, J. M. Glenn, W. B. Pratt and others.

CANTON, OHIO — Canton-Akron Railway Company. $600,000. Incorporators: William H. Hoover, W. A. Tucker, A. C. Brant and others.

PARKERSBURG, IOWA—Parkersbug Telephone Company. $10,000. Incorporators: G. G. Bickely, C. F. Bennett, R. F. Camp and others.

EAST LIVERPOOL, OHIO—Ohio River & Norristown Railroad Company. $10,000. Incorporators: W. S. Snyder, G. R. Long, W. E. Nye and others.

AUSABLE, N. Y.—Ausable Electric Light and Power Company. $25,000. Directors: James Rogers, George Cahoon, H. G. Rogers and others.

EDGERTON, PIPESTONE COUNTY, MINN. —Enterprise Telephone Company. $50,000. Directors: Edward Yocum, E. W. Davies, C. G. Brady and others.

HAVERHILL, MASS.—Haverhill & Plaistow Street Railway Company. Capital not stated. Directors: W. B. Lovell, I. M. Heath, R. N. Elwell and others.

AUGUSTA, ME.—United States Construction and Engine Company. $1,000,000; paid-up capital, $500. President, L. M. Foster; treasurer, H. J. Livermore.

ELLSWORTH, ME. — Ellsworth Manufacturing Company. $10,000. To manufacture and deal in automobiles. President, L. F. Giles; treasurer, H. C. Stratton.

FRENCHTOWN, N.J.—Frenchtown Electrical Construction Maintenance Company. $50,000. Incorporators: P. J. Magee, Franklin Dewsnap and J. S. Gilbert.

LOUISVILLE, KY.—The Louisville Anchorage & Pewee Valley Electric Railway Company has increased its capital stock from $10,000 to $34,000. H. H. Bechtel, president.

THE DALLES, ORE.—Interstate Power Company. To operate an electric light plant. Capital not stated. Incorporators: E. Kurtz, E. M. Williams, M. A. Vogt and others.

COLUMBUS, OHIO — Columbus, Delaware & Marion Electric Railroad Company. $1,000,000. Incorporators: S. T. Everett, H. C. Parke, J. W. Holcomb, D. C. Beggs and others.

EAST WINDSOR, CT.—East Windsor Street Railway Company. $24,000, with privilege to increase to $100,000. Incorporators: James Price, J. B. Noble, J. J. Lawton, G. S. Phelps and others.

ROCKFORD, ILL. — Freeport Electric Railway Company. $50,000. To be constructed from Rockford to Freeport. Incorporators and directors: T. M. Ellis, J. H. Catlin, F. M. Puffer and others.

PORTLAND, ME.—Union Stop and Signal Company. $50,000. To manufacture electric and mechanical devices. President, W. B. Everett; treasurer, J. C. Brady, both of Fall River, Mass.

TRENTON, N. J.—International Electric Company. $3,000,000. Incorporators: A. H. Miller, C. M. King and S. C. Smith. To build and operate plants furnishing electric light, heat and power.

LYONS, N. Y.—The Wayne County Electrical Company has been formed with a capital of $100,000 by consolidating the Lyons Electric Light and Power Company with the Lux Electric Light, Heat and Power Company, of Clyde.

The Dayton Fan and Motor Company Enjoined.

In the United States Circuit Court for the southern district of New York Mr. Justice Lacombe has just rendered an important decision in the suit of the Diehl Manufacturing Company *vs.* the Dayton Fan and Motor Company, of Dayton, Ohio, for infringement of patents upon electric fans. The patents in litigation are Nos. 537,679 and 585,250. The opinion of the court is of much interest. It sustains the former decision of the same case in the circuit court and preliminary injunction has been issued. The patents refer to ceiling fans and electrolier ceiling fans and devices used in connection with them, and are regarded as of a broad and fundamental character.

A Convenient Medical Battery.

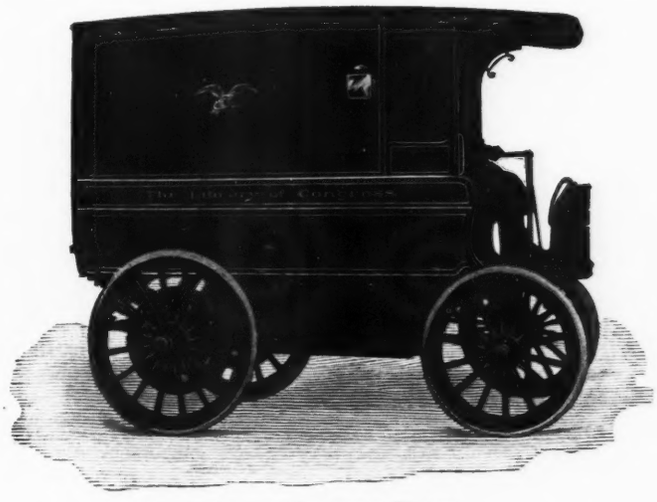
The medical battery outfit represented in the accompanying illustration is one of much simplicity and ingenious design. The cylindrical case of the apparatus contains a dry battery, the induction coil and vibrating interrupter being mounted in the upper part, while the electrodes, roller,

A Compact Electro-Medical Battery.

etc., pack up together in an exceedingly small space, making it convenient to carry in the pocket. The apparatus is manufactured by the Dunn-Martin Electric Company, New York.

An Electromobile Delivery Wagon.

The electric delivery wagon illustrated herewith was recently purchased by the United States Government from the Electric Vehicle Company, for the distribution of books from the Congressional Library. It has been in operation for over a month by the library authorities and



Electromobile Delivery Wagon.

it is said that they have expressed the highest satisfaction with its performance.

Another delivery wagon of the same general type is under contract to carry the mails between the post office in Buffalo and the Pan-American Exposition grounds. The wagons have a carrying capacity of 1,000 pounds of goods besides the driver and attendant, and equipped with the new long-distance batteries now used by the makers; they have a running radius of about 35 miles on one charge and a speed of 11 miles per hour.

Some New Types of Automobiles.

In undertaking the manufacture of electric vehicles the Scott Automobile Company, of St. Louis, Mo., has embodied in its design a number of novel and interesting points. The running gear is stated to be of great strength and durability and is built upon a design which is thought gives the best results in service. The motor is of a modern enclosed type, dust-proof, and having its commutator

Electric Stanhope.

and brushes easily accessible. The battery, which is shown in the accompanying illustration, is of 40 cells and is claimed by the makers to give extraordinary results in mileage capacity and long life under difficult uses. While a number of vehicles of different types are constructed only one, the stanhope, with top, is illustrated here. The vehicle is fitted to the gauge of street car tracks, which is a great convenience when it is used in cities. It is roomier than the average designs of this type, giving room for carrying a number of articles, adding materially to the comfort of the rider.

OBITUARY.

Mr. John C. Henry, of Denver, Colo., an electrical engineer of note, died at his home in Denver on May 4. Mr. Henry was born in Woodstock, Ontario, fifty-three years ago and for a long time lived in New York city, leaving for Denver in 1894, when his health failed. He was one of the pioneers of the electric railway, having built a line at Kansas City in 1886. Prominent among his inventions were numerous improvements of the overhead trolley. He had lately been engaged in electric railway engineering in the Colorado mountains, having built a remarkable mountain road into Cripple Creek.

Mr. Watson Van Benthuysen died recently at his home in New Orleans. Mr. Van Benthuysen was at one time president of the New Orleans and Carrollton and Crescent City railways. He built the Coliseum line and had for many years been a prominent factor in New Orleans commercial enterprises.

Automobile Stages on Fifth Avenue, New York.

An electric stage line will soon be operated on Fifth avenue, in New York city, according to the plans of the Fifth Avenue

Storage Battery for Electric Vehicles.

Stage Company. The ones used last year were found inadequate to the traffic and the new ones will have longer bodies, smaller wheels, two cross seats on top and larger batteries. It is expected, with a maximum load, one of the new stages will be able to run 30 miles without recharging the batteries and 40 miles with the average changes of load. The stages will be equipped with a new motor which has been constructed so that they will be able to make satisfactory speed. Four new vehicles will be in operation by May 15 and two, which will carry 32 passengers each, by June 1.

The car sheds of the Brooklyn, N. Y., Rapid Transit Company on Flushing avenue were destroyed recently by fire, the loss reaching about $100,000. The company will probably not rebuild the sheds as they were used only for temporary storage pending the sale of property, and as the company has ample facilities for storing cars elsewhere.

Industrial Notes

THE NEW YORK OFFICE of the Shelby Electric Company has just been removed to the Parker Building, Fourth avenue and Nineteenth street. Mr. J. C. Wormley continues as manager of the eastern and export department for this company.

THE WESTERN ELECTRIC COMPANY opened its new building in Philadelphia, 933 Market street, on Wednesday, May 8. Handsome steel-plate invitations to the opening were issued. This company will carry a complete stock of electrical apparatus and supplies.

THE IBERIA ELECTRIC SUPPLY COMPANY, of which Mr. A. G. Nauch is president, has been organized at New Iberia, La., to do a general electrical supply and construction business. The company will be glad to receive catalogues of different electrical manufacturing companies.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising its new hotel telephone system, which it claims has a big field in replacing the present telephone and annunciator service now in vogue in hotels and apartment houses. Particulars will be sent on request.

THE SANDUSKY TELEPHONE COMPANY issued an illustrated souvenir booklet on the occasion of the formal opening of its exchange, which was illustrated and described in the ELECTRICAL REVIEW last week. Copies of this interesting booklet can be had upon enclosing two cents postage to the company at Sandusky, Ohio.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has an exhibit in section F of the Electrical Building at the Pan-American Exposition. This exhibit will contain a number of old and curious rheostats, and also modern rheostats and will give a good idea of the progress and improvement which have been made in the manufacture of this class of apparatus.

MR. EDWARD P. THOMPSON, solicitor of patents and experienced in electrical work in this field, has removed his office from 81 Fulton street to 156 Fifth avenue, New York, N. Y. This removal brings Mr. Thompson's office within a few minutes' walk of his home in Gramercy Park, and he calculates that it gives him a day each week for serving his clients which has hitherto been spent in traveling to and from his former office downtown.

THE NEW ENGLAND STREET RAILWAY CLUB bulletin for March contains a full report of the monthly meeting of the club, which was held at Boston, Mass., on February 28. The officers of the club are: President, H. E. Bradford, of the Worcester Consolidated Street Railway Company; vice-presidents, L. H. McLain, C. A. Bodwell, W. G. Meloon and F. G. Daniels; secretary and treasurer, Fred W. Teele, of the Boston Elevated Railway.

THE CROUSE-HINDS ELECTRIC COMPANY, manufacturing electricians, Syracuse, N. Y., is now well installed in its spacious and newly modeled factory fronting Armory Square. The ground floor is given wholly to the suite of private offices for the officers of the company and heads of departments, while the several upper floors are devoted to manufacturing equipments. The growth of this company during the last two years has been rapid and substantial.

THE DE DION-BOUTON "MOTORETTE" COMPANY, Thirty-seventh street and Church lane, Brooklyn, N. Y., has recently issued a new price list of its motors and motor accessories. The list gives the prices for the different sizes of motors manufactured by this company and also a complete line of its accessories. The company also announces that under the management of Mr. C. G. Ridgeway, who is well known and formerly conducted a similar business in Paris, it has greatly increased its department pertaining to its accessory business.

MR. GEORGE H. DANIELS, general passenger agent of the New York Central & Hudson River Railroad, has sent out a number of advance copies of No. 13 of the four-track series, which is a very interesting number. It gives in a very small space a clear idea of the advancement made by the United States during the past 10 years, and shows the wonderful growth of cities of the United States and particularly the development along the lines of this great railway system. As a ready reference it will command a place on every editor's desk.

THE MANUFACTURERS' ASSOCIATION, of Kansas City, Mo., recently has established a catalogue library, and through its secretary, Mr. W. C. Winsborough, Lyceum Building, Kansas City, requests all manufacturers and mercantile establishments to forward their catalogues, receipt of which will be duly acknowledged. The association will maintain standing advertisements in all of the local papers announcing that the catalogue library is at the service of any one, and that inquiries by mail, any of which can be answered by reference to the catalogue library, will be given prompt attention and replies freely made.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, 118 and 120 Jackson Boulevard West, Chicago, Ill., is mailing its telephone inspectors' handbook, giving tables on annunciator wire, induction, and a great number of testimonials as to the worth of the company's apparatus. Besides the tables and general information, the book is illustrated throughout with designs and cuts of instruments, being accompanied by a slip bearing a removal notice, which states that the company on March 1 removed to its new factory building, corner of Jackson Boulevard West and Desplained street.

THE CENTRAL ELECTRIC COMPANY, 274 to 290 Fifth avenue, Chicago, Ill., is mailing a new price list of its I. X. L. weather-proof double galvanized telephone and magnet wires and lamp cord, the prices going into effect on April 5, and subject to change without notice. The company also especially advertises its D. & W. combination cutouts and Manson tape in a tin box. Further changes in the company's prices are announced for locust pins, oak pins, lag screws, carriage and machine bolts, pony glass insulators, telephone cross-arms, double galvanized B. B. wire, and ordinary styles of dry batteries. Special prices on the 1900 and Columbia dry batteries will be mailed to any one interested on request, and upon receipt of exact specifications the company states that it can name very attractive prices. This company is the sales agent for the International Conduit and Cable Company and also has the agency for the well-known Okonite wires and cables.

THE AMERICAN BRIDGE COMPANY will make quite an elaborate building exhibit at the Pan-American Exposition, furnishing two buildings, each about 60 feet in width and about 150 feet in length. One of the buildings will be of extremely plain construction, being designed for use as a manufacturing plant. The second, however, will be of ornamental design, such as would naturally be used for freight depots, street-car barns, and that class of structure. The company will also make an extensive exhibit of parts of large bridges. The American Bridge Company will furnish to J. G. White & Company, New York, the structural steel work for the power plant for the Kalgoorlie Electric Power Company, Kalgoorlie, Australia. This plant consists of an engine house 43 feet by 159 feet with a lean-to 17 feet by 40 feet, and a boiler house 41 feet by 132 feet. A representative of White & Company is now in Australia arranging for the installation.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, Pa., is mailing a handsome calendar illustrative of the I-T-E circuit-breaker for railway work. The calendar is done in red and mounted upon a crimson board which bears two views of the I-T-E circuit-breaker in silver, bronze and black. On the back of the board the company gives 15 reasons why the apparatus has received the cordial support which the company claims it has met. "I-T-E" is said to stand for "inverse time element," which may be defined as the time element of action in inverse proportion to the current, which means that the heavier the current the quicker the action, or the greater the charge or necessity the quicker the relief; in other words, as the conditions of the circuit protected approach nearer and nearer to a short-circuit, the time of opening the circuit becomes less and less; the principle which makes circuit-breakers practicable. The company will take pleasure in mailing its complete catalogue upon request from persons interested.

THE MERITS OF THE FRINK SPECIAL PATENT WINDOW REFLECTOR are well known. This enterprising and progressive house is not only lighting the finest department stores in this country, but is reaching out after foreign trade as well. Among the latest installations in the show window line is the J. E. Manix Dry Goods Company, of Nashville, Tenn.; the show windows of the large department store of Señor Tomas Mendirichaga, Monterey, Mexico, who also used a large number of cluster reflectors for lighting the interior of the store; and a large order for the show windows of one of the best known houses in Dublin, Ireland, which orders indicate that the fame of the Frink reflector is widespread. For the thorough diffusion of an even light over the entire window space, without glare in the eyes of the observer, there is nothing to excel it; it makes the ideal light for show windows, says the manufacturer. A line of cluster reflectors manufactured by this firm for the lighting of store interiors, give a splendid light and are very durable. The firm, I. P. Frink, 551 Pearl street, New York, will cheerfully furnish any information desired on request.

THE BUNNELL TELEGRAPHIC AND ELECTRIC COMPANY, 110 to 120 Beekman street, New York, well known throughout the electrical field as one of the most progressive and energetic supply houses for electrical apparatus, has recently purchased the plant and business of the National Electric and Manufacturing Company, of Milford, Ct., and has assumed control of the plant and apparatus of the new company. It is the intention of the new owner to entirely remodel the interior of the factory, install more modern machinery, and extend the present facilities for output, and while the present force of hands will be employed, a large number of skilled workmen will be added to them. The Bunnell Telegraphic and Electric Company has also recently made several large additions to its supply house and factory at 110 to 120 Beekman street, New York city, having purchased and equipped throughout the building located next door, 118 and 120 Beekman street. The New York establishment with this recent extension now numbers from 110 to 120 Beekman street, occupying nearly the entire front of that block where the company will retain its offices and salesroom. The company has thus greatly increased its facilities for manufacturing general electric, street railway, telephone and telegraph supplies. It is adding valuable improvements to the district, burglar and fire-alarm call boxes and registers manufactured by the National company, and has just issued a large and complete catalogue which contains many new departures in its line.